FACTORY

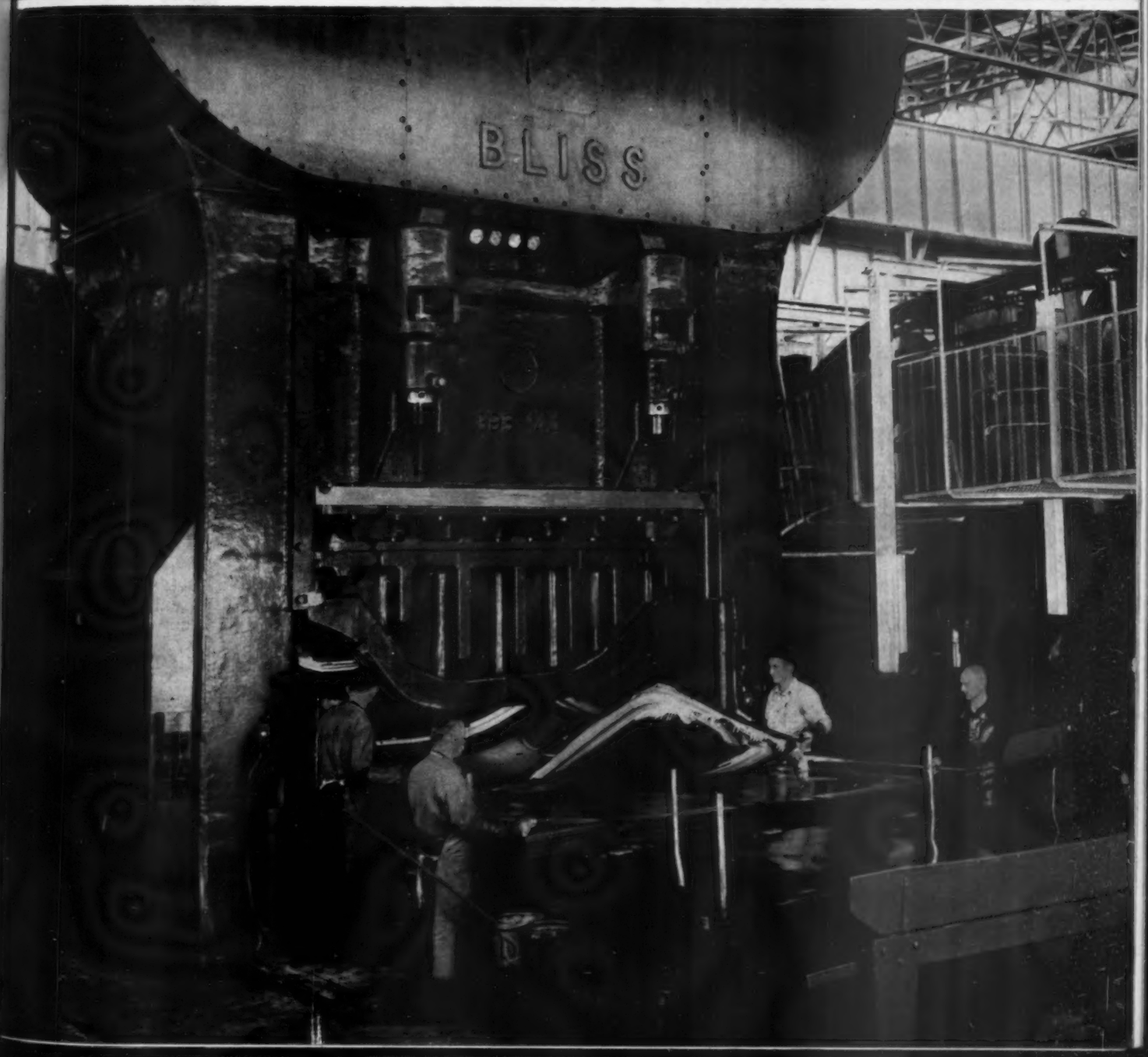
MANAGEMENT AND MAINTENANCE

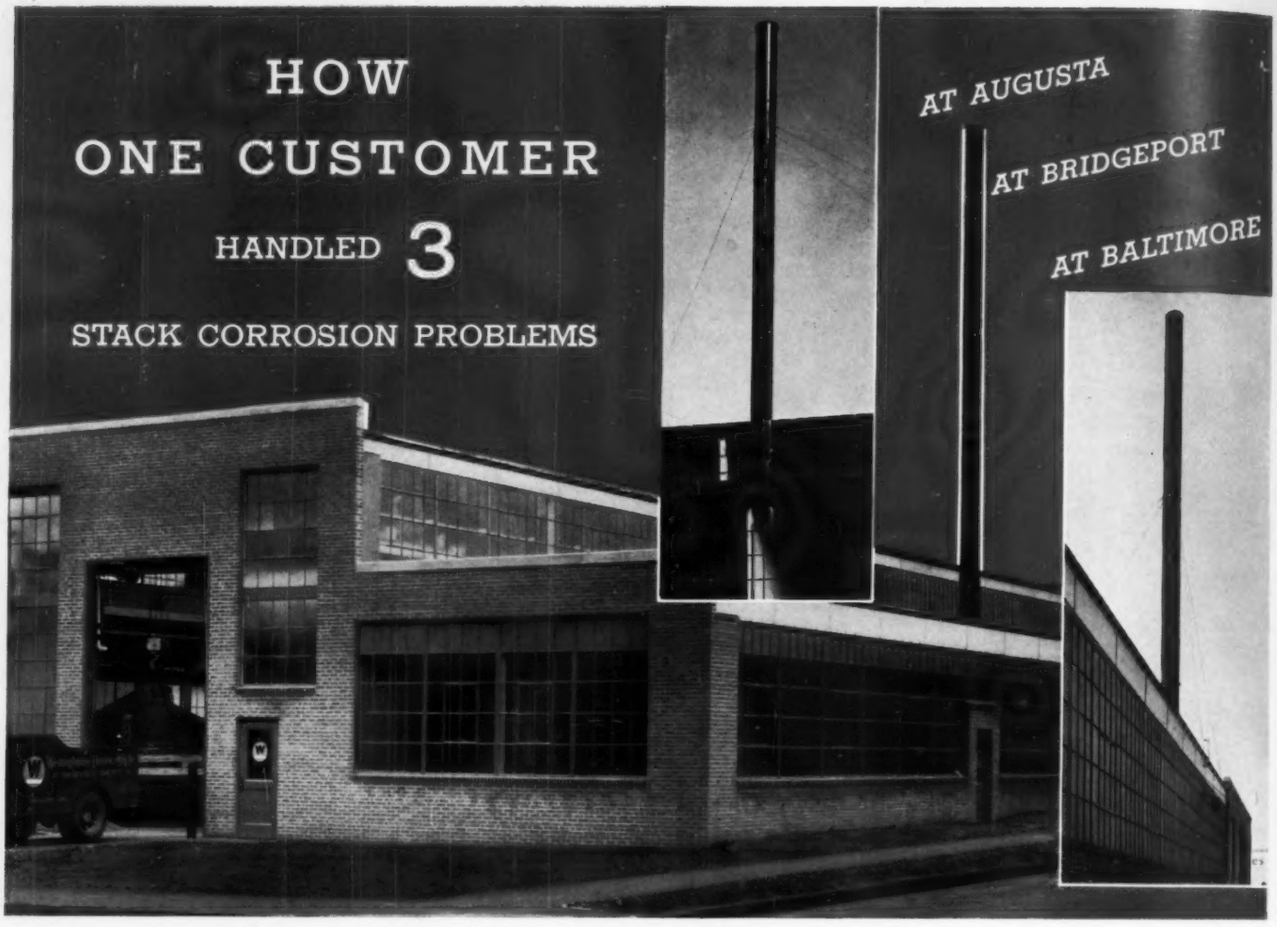
A McGRAW-HILL PUBLICATION

SEPTEMBER 1941

FROM BUTTER TO GUNS

PAGE 50





BYERS WROUGHT IRON

Three stacks (two 24" x 65', the other 24" x 68') recently erected at Westinghouse plants at Augusta, Me.; Bridgeport, Conn.; and Baltimore, Md.; were built of wrought iron. We believe this is further evidence that American manufacturers who place emphasis on engineering in the design and manufacture of their products apply the same principles in selecting materials for plant services.

In stacks, corrosive attack from carbonic acids can always be expected. If the fuels used contain any sulfur compounds, the severity of attack is increased. Engineering experience furnishes plenty of evidence of the ability of wrought iron to resist such corrosion. A Pennsylvania water company, for example, replaced the top section of a 30-year-old wrought iron stack with another material, which failed after only five years . . . an indicated service ratio of six to one.

The great expansion in industrial activity is taxing the capacity of many power plants today . . . and making possible shut-downs a nightmare to engineers who once accepted frequent stack repairs and replacements as natural and normal. Present or prospective use of cheaper fuels brings a threat of increased corrosive attack. If you have any problems of this nature, it will pay you to find out what wrought iron has done for others . . . and what it can do for you.

Our Engineering Service Department will be glad to give you facts and figures on the performance of wrought iron in applications similar to those you have in mind as a help in selecting materials for maximum service. An interesting discussion of the corrosion problems encountered in stacks, and examples of how engineers are successfully using wrought iron, is contained in our bulletin, "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment." We will gladly send you a copy, on request.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

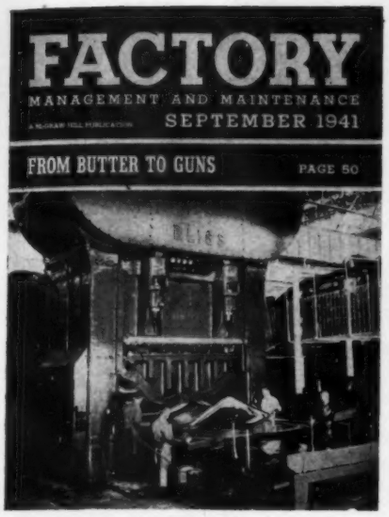
DATA ON RADIANT HEATING!

Our bulletin on this important subject has been completely rewritten and greatly expanded. Would you like a copy?

BYERS GENUINE WROUGHT IRON

TUBULAR AND FLAT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS



The "big fellow" on this month's full-color cover is at the Ford River Rouge plant. It stamps out top body panels, the largest single panel that goes into Ford and Mercury cars. With its sub-base the press weighs 450 tons, exerts a pressure of 750 tons on a piece of sheet metal that weighs 100 pounds, stamps 200 top panels an hour. Die weighs 80 tons, punch 35. Takes six men to handle the job—two feed press, two remove top panels, two are operators. Kodachrome by courtesy of Ford Motor Company.

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FACTORY
MANAGEMENT AND MAINTENANCE

SEPTEMBER · 1941

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Easton has put more men to work, has greatly increased manufacturing facilities, and has taken other decisive steps to meet today's unprecedented demands. Industrial cars of all types, trailers, electric trucks and other material handling units are rolling out at a pace we once thought impossible.

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FACTORY
MANAGEMENT AND MAINTENANCE
L · C · MORROW · EDITOR

For Your Own Sake—Help Make Supplies-Priorities Work

THE FLOW OF SMALL TOOLS and other industrial supplies for use on defense production is threatened. Ironically, it is the user—the man whose production cannot go on without these items—who is responsible. Here is what is happening:

a. The manufacturers of industrial supplies (such as screws, bolts, drills, files, electric motors, portable power tools, power transmission) are subject to priority regulations. Unless they have priority, they cannot get the raw materials needed in making the supplies.

b. It is only when the supplies are to be sold to manufacturers working on defense orders that priority rating can be secured.

c. Manufacturers working on defense orders are not cooperating to make available the information on which priorities could be obtained.

Up to this time, stocks of tools and supplies have held up pretty well. So have stocks of maintenance and repair parts. However, it seems obvious that, beginning now, users of these essential products are going to feel the pinch of scarcity.

The deplorable situation, in which the users themselves are bringing about the shortage, can be remedied by full participation in the following procedure:

1. The Priorities Division of OPM has established the "Defense Supplies Rating Plan," which sets up, for the manufacturer of supplies, including maintenance and repair parts, a priority for future business based on the record of his past business.

2. Manufacturers (of supplies) granted use of the plan, determine the percentage of their total production that goes into defense channels and are given priority ratings on that part of their materials requirements.

3. The percentage figure for each manufacturer (of supplies) is determined from information furnished by his customers. This information is requested by either the supply manufacturer or mill supply distributor.

The manufacturers of defense products must cooperate in item 3 or the whole procedure falls down. If all manufacturers *do* cooperate, the tools, supplies, and equipment will be manufactured in advance of need and placed on the distributors' shelves for immediate availability. This is true, whether the manufacturer of defense equipment buys from the mill supply distributor or direct from the manufacturer of the supplies.

Manufacturer cooperation is intended to be carried on by means of certain regular procedure that has been set up. Details can be secured from the Priorities Division of OPM, from the mill supply house, or from the manufacturer of the supplies.

I hope that all manufacturers of defense products will help make the Defense Supplies Rating Plan effective. It is not just a pious hope I express, with the idea that it will be nice if somebody does something for somebody else. I'm saying, instead, "Do this in your own self-interest. You're going to be in a bad way if you have to wait for tools and supplies to be made after you've ordered them."

L C Morrow

From Butter to Guns

Materials shortages now confront 5,000 non-defense plants. Management must seek defense work and practice substitution, conservation, and salvage of critical supplies

THE LONG-PREDICTED PERIOD of scarcity and shortage is upon us. As the priorities brake tightens on the wheels of non-defense plants, the early appraisals of the slowdown's probable effect range as high as 5,000 factories wholly or partially closed and 2,000,000 employees temporarily or permanently displaced.

Time will tell whether these figures exaggerate — or under-estimate — the gravity of the situation. But producers of peacetime goods must begin now to study the priorities dilemma and explore every remedial course. The individual company's welfare, the preservation of national morale, and our future economic stability are at stake.

As a guide to possible policy, FACTORY has prepared the "Butter to Guns Check List" which accompanies this article (pages 53-56). Necessarily general, it may fail of application to many specific cases; in many others it may prove to be of minor value. *Unfortunately, but undeniably, many companies face a problem that is without promise or prospect of solution.*

A Hard Course to Steer

In appraising the general outlook, the course between despair and undue optimism is a hard one to steer. An outstanding defense official, in a recent interview with FACTORY's reporters took this moderate view:

"The position of some companies, I admit, is well-nigh hopeless, as deplorable as war itself. But I think most of those affected by the priorities pinch will contrive to survive by virtue of the very enterprise and ingenuity with which they launched their businesses in the first place."

As background for study of the charts and check lists contained in these pages, there follow some observations and comment on national policy and some pointers on action that management can take in the interest of industry as well as that of the individual company.

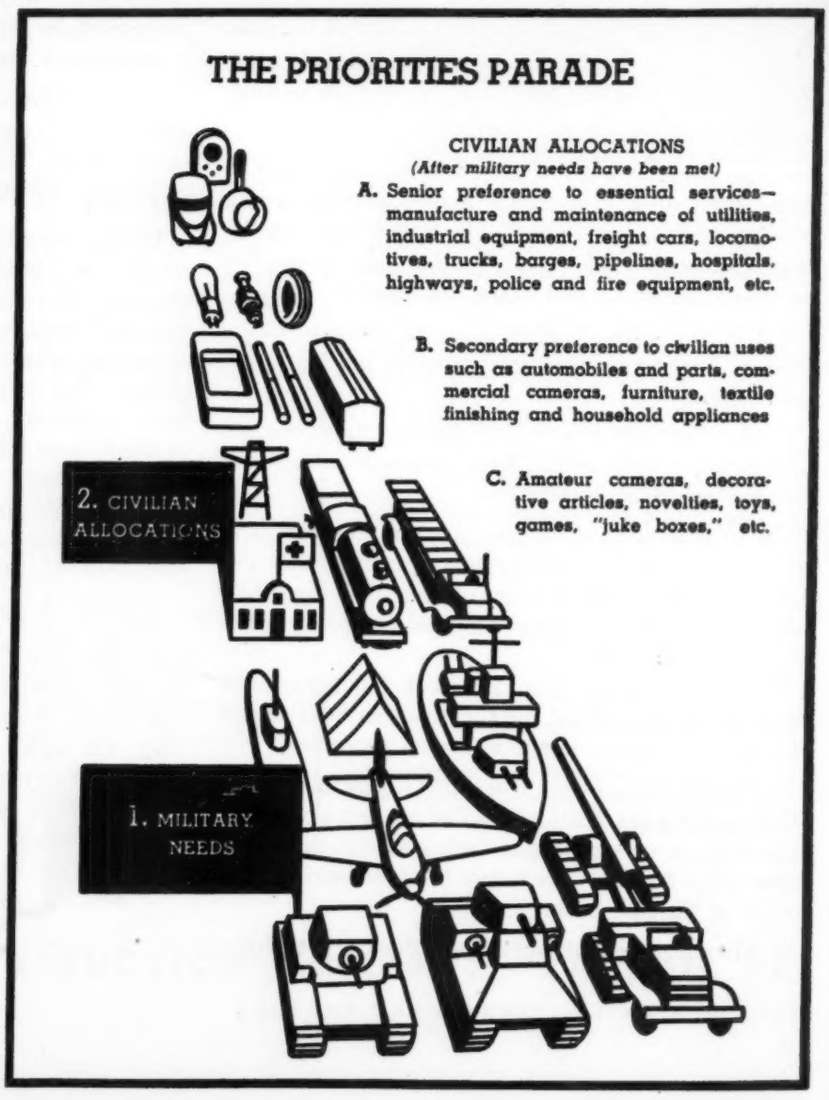
The industrial dislocations of defense, if the experience of other nations is an indication, follow a fairly clear pattern. First, the speed-up in arms production, then shortages, then priorities, then curtailment of non-essential civilian goods, then unemployment, then conversion of suitable facilities to munitions work, and finally full re-employment with heavy emphasis on guns rather than butter.

Consumer durable goods and luxury goods requiring special metals are the first and hardest hit. Experts predict that every known metal is sure to be at least partially restricted in America for a time. As mining and processing capacity expands, we alone among the nations have some chance of regaining our balance.

Meanwhile the problem is being approached (1) on a national and industry-wide basis, (2) on a community basis, and (3) on an individual basis.

Foremost among possible solutions are (1) direct or indirect defense work, (2) conservation, salvage, and substitution of materials, both as national and individual expedients.

What is the government doing


THE PRIORITIES PARADE
CIVILIAN ALLOCATIONS
(After military needs have been met)
A. Senior preference to essential services—manufacture and maintenance of utilities, industrial equipment, freight cars, locomotives, trucks, barges, pipelines, hospitals, highways, police and fire equipment, etc.
B. Secondary preference to civilian uses such as automobiles and parts, commercial cameras, furniture, textile finishing and household appliances
C. Amateur cameras, decorative articles, novelties, toys, games, "juke boxes," etc.
2. CIVILIAN ALLOCATIONS
1. MILITARY NEEDS

A defense clinic in action—New York leads the way. For description see Item 11 in "Butter to Guns Check List"

about non-defense industry? Everything and nothing. In the vast, rambling reaches of our bureaucracy there is no one agency addressed to this problem alone. Yet there are at least twelve subdivisions of government that have bearing, major or marginal, upon it. Some of them have launched promising, if unrelated, attempts to ease the transition tension.

To attempt to analyze all these agencies, their work, and their relationships would require a book, a good big book. In the Check List, reference is made to some of the government activities that affect non-defense management in its own planning. Over-all, one hopeful trend stands out—the general effort to localize government-industry contact. The development of the Defense Contract Service (See Check List, Item 12) is highly encouraging.

For the future we may look for creation of a central governmental unit to pull together the activities of the many agencies whose work touches on non-defense industry's problems.

Another strong possibility is a drive to speed up defense spending on a "forced draft" basis—to re-negotiate contracts and revise delivery dates, then push defense work out into the ramifications of each industry through defense industry committees.

Plus this we may see versions of the British "bits and pieces" plan. Worthy of study is the "bits blitz" staged by the Canadian pulp and paper industry which has produced $400,000 worth of war goods in its own repair and machine shops—and expects to increase this output ten fold next year.

What is being done on a local or community basis? Before the war, York, a Pennsylvania city of 55,000, made safes and locks, refrigerating and air conditioning machinery, machine tools, wire cloth, and a wide spread of other goods. Today it makes gun mounts, trench mortars, machine guns, powder presses, and scores of other munitions items in a coordinated program that enlists the minds and hands of virtually every management and every worker in the city. York has no recollection of a painful period of dislocation and unemployment in the switch to a defense footing.

Potent factors for the solution of industrial problems in this critical period are manufacturers' associations, such as that which put over the York plan, commercial and business groups, bankers, trade unions, editors, and engineers—if they work together. Tied in with the newly localized branches of federal and state defense agencies, they will play an even more important role henceforth. Another sort of a job is marked out for them also in the new program getting under way in Canton, O. There the manufacturers, dissatisfied with the current progress of defense production, have joined forces to speed it up by organized subcontracting.

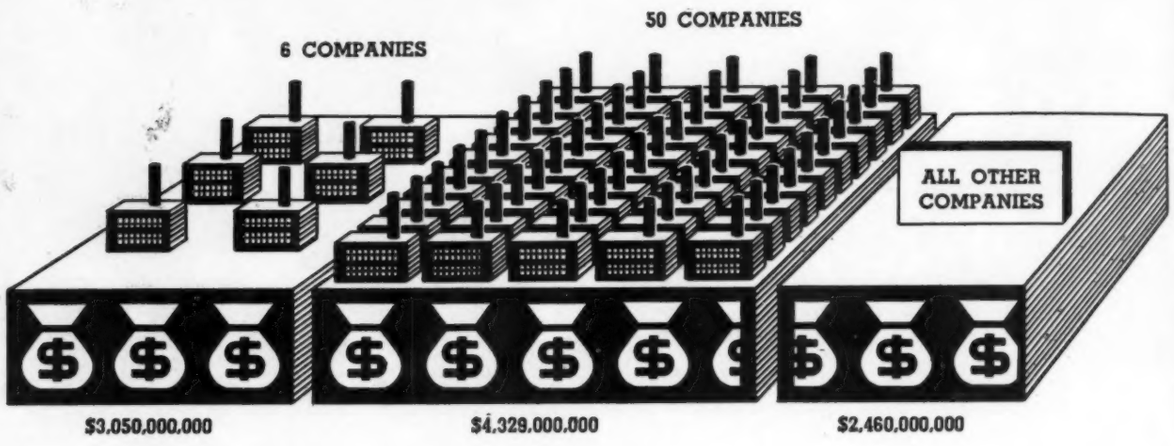
Defense clinics also will come to the fore. An example worthy of imitation is the New York clinic (described in the Check List, Item 11, and pictured on this page). Later defense goods "showcases" may be set up with typical items on display.

What can the individual manufacturer do, not only to help his own company but also to help industry and the defense effort generally? For one thing, try to avoid paying scalpers' prices for materials. Secret speculation is not only costly to the purchaser, it also thwarts price control and undermines economic stability.

For another thing, join enthusiastically in all proposals for conservation, reclamation, and substitution of critical materials. Report any discoveries you may make in these fields promptly to the Conservation Section of OPM.

What are the individual company's

TRY FOR A DEFENSE CONTRACT — PRIME OR SUB



Of the $9,839,000,000 of prime contracts awarded during the first year of defense, 6 companies received 31.5 percent. These 6 and 50 others received 75 percent. These contractors are rapidly becoming overloaded with orders, which improves the opportunities for other companies to secure either prime or sub contracts.

chances of getting defense business? There is no rule. The answer depends on specific circumstances. Some companies, no doubt about it, face an impossible situation. It is a fact that a former high OPM official, who hurried home to put his own business to rights, hit a stone wall in his hunt for defense contracts. Yet his search was about as exhaustive as it well could be, covering every item in the Check List and some more besides. He finally went to Washington where, naturally, he was able to interview officials who seldom have time for such callers. But the government already had ample sources for the defense products he proposed to make. And that was that.

Still, the fact remains that some 60,000 contracts in amounts of $100,000 or less will be let directly this year, to say nothing of bigger prime orders and the vast amount of subcontracting that will be spread through industry. Conversion of facilities is a reality. Business machine and battery plants are making bomb fuses, sewing machine plants are making automatic pistols, printing equipment plants are making telescopes, and so forth.

No manufacturer can call himself "out," therefore, until he has probed his prospects fully. Especially if he has machine shop facilities.

All manufacturers deserve a better-coordinated reception from the procurement departments of the government—which may come in time. Yet procurement officers have their side of the story. They contend, and rightly, that many non-defense companies were ducking defense business before the shortages set in. Moreover, one top defense official, himself a businessman of note, declares that in six out of ten cases that he studied personally, the only obstacle that stood between the prospective new contractor and an order was price.

What about "contact men"? Defense business agents are beginning to appear on the scene in large numbers. There is little hint of champagne salesmanship or "gratuities," but the fees that these men charge for a straight selling job are often extremely high.

Some of these agents unquestionably are doing a keen, legitimate job of analyzing product capacity and ferreting out government markets. In their wake, however, come lesser gentlemen who affect an air of mystery, pocket fat retainers, and display nothing on the ball at all. It is hard for a prospective client to distinguish between the breeds.

At best, the "contact man" adds to the cost of the defense effort. If he collects $50,000 on a $1,000,000 job, he probably makes more than anyone else concerned. And when he gets results, he has probably done no more than the average manufacturer could have done for himself by diligent and intelligent study of his prospects.

Scarce Materials

Ratio of civilian demand to civilian supply

Aluminum	15 to 1
Alloy steels	2 to 1
Chromite	3 to 2
Copper	5 to 2
Cork	10 to 1
Lead	1 to 1
Manganese	3 to 2
Mercury	3 to 2
Mica	5 to 3
Nickel	2 to 1
Nitrates	8 to 7
Plastics	3 to 2
Rubber	10 to 7
Steel plate	3 to 2
Steel, other than alloy or plate	10 to 9
Tin	3 to 2
Tungsten	2 to 1
Zinc	3 to 2

Other materials, actually or potentially scarce, include magnesium, brass, antimony, burlap, manila fiber, tapioca, ilmenite (a paint ingredient), silk, jute, vanilla, spices.

"Butter to Guns" Check List for Manufacturers

★ The non-defense manufacturer, faced with materials shortages due to priorities, has these three approaches to consider:

1. Try to stay in the present line of business.
2. Try to find lines utilizing materials not affected by priorities
3. Try to "get in" on priorities by getting defense business, by subcontracting, or by entering lines allied to those that enjoy civilian preference rating.

★ The following check list is NOT a guaranteed solution to specific problems.

★ Nor is it an infallible guide through the mazes of government agencies that confront the individual.

★ Quite possibly a major new government agency will be dedicated to these particular problems. Its creation may be announced between the time this list was compiled (August 25) and the time you read it. Even so, some time will pass before such an agency can be organized for effective action. Meanwhile it may pay to check this list.

---

1. Keep up with events in industry and government

Information, in industry as in war itself, is of first importance, especially in today's confused, fast-changing situation. Key information sources, varying in value with local circumstances, are: (1) manufacturers' associations, industrial divisions of Chambers of Commerce, or both; (2) trade associations; (3) business magazines; (4) engineering and technical societies; (5) the officers of local banks; (6) daily newspapers; (7) business associates and friends.

These groups will play a recurring role in the suggestions set forth elsewhere in these pages.

2. Explore all sources of supply

The shortage of materials for non-defense products may be purely local. The assertion of a single supplier that he is out of stock and that no stock is available elsewhere need not always be taken at face value. Frequently the needed material may be found in the stocks of nearby suppliers or among those in other cities where, perhaps, the demand is less.

Here trade, industrial, and business associations can be helpful. An inquiry, addressed by them in the member company's behalf to their correspondents in other cities, may turn up unsuspected sources.

3. Anticipate shortages, try to find substitutes

"Over the desk of every top industrial executive and every designing engineer should hang a list of materials in which shortages have occurred or are expected," says a leading OPM conservation official.

Substitutions are coming to the fore—rubber for corks, glass for metal, plywood for galvanized sheets, and so forth. Industry is working diligently and with some success to devise them, despite the dismaying danger that shortages may develop in the substitutes themselves. The automotive industry has cut out nickel and reduced to less than half its use of copper, chromium, and aluminum.

OPM's Production Division now has a Conservation Section, with subsections on substitutions and reclamation. It is aided by advisory committees from the National Academy of Science. Again, the manufacturers' and trade associations, business papers, and engineering societies will help to keep the individual abreast of developments in this field.

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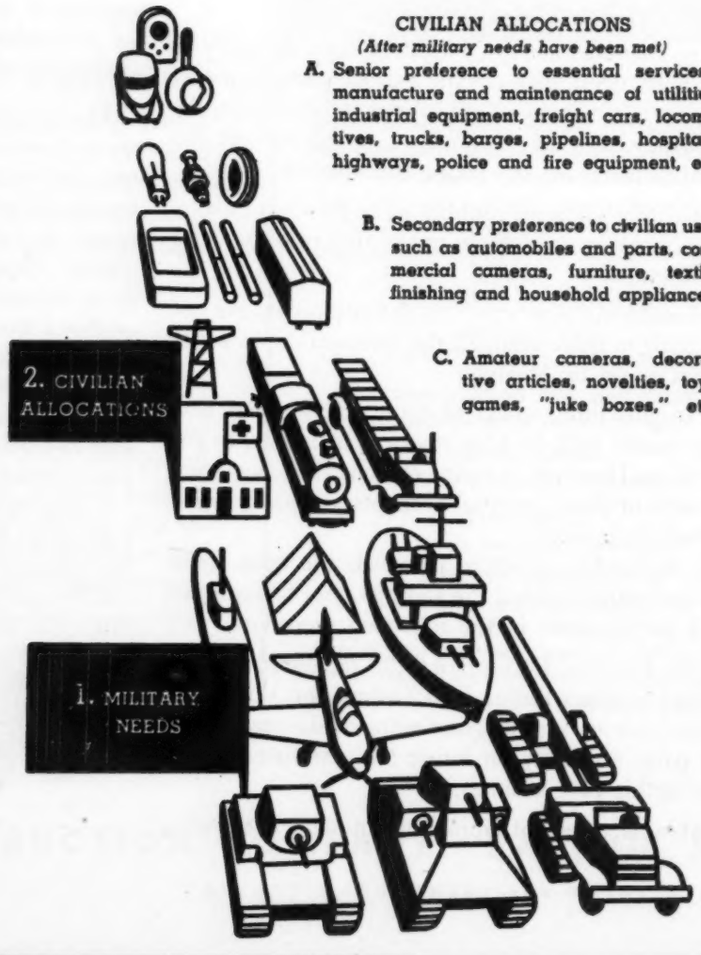

CIVILIAN ALLOCATIONS
(After military needs have been met)

A. Senior preference to essential services—manufacture and maintenance of utilities, industrial equipment, freight cars, locomotives, trucks, barges, pipelines, hospitals, highways, police and fire equipment, etc.

B. Secondary preference to civilian uses such as automobiles and parts, commercial cameras, furniture, textile finishing and household appliances

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What is being done on a local or community basis? Before the war, York, a Pennsylvania city of 55,000, made safes and locks, refrigerating and air conditioning machinery, machine tools, wire cloth, and a wide spread of other goods. Today it makes gun mounts, trench mortars, machine guns, powder presses, and scores of other munitions items in a coordinated program that enlists the minds and hands of virtually every management and every worker in the city. York has no recollection of a painful period of dislocation and unemployment in the switch to a defense footing.

Potent factors for the solution of industrial problems in this critical period are manufacturers' associations, such as that which put over the York plan, commercial and business groups, bankers, trade unions, editors, and engineers—if they work together. Tied in with the newly localized branches of federal and state defense agencies, they will play an even more important role henceforth. Another sort of a job is marked out for them also in the new program getting under way in Canton, O. There the manufacturers, dissatisfied with the current progress of defense production, have joined forces to speed it up by organized subcontracting.

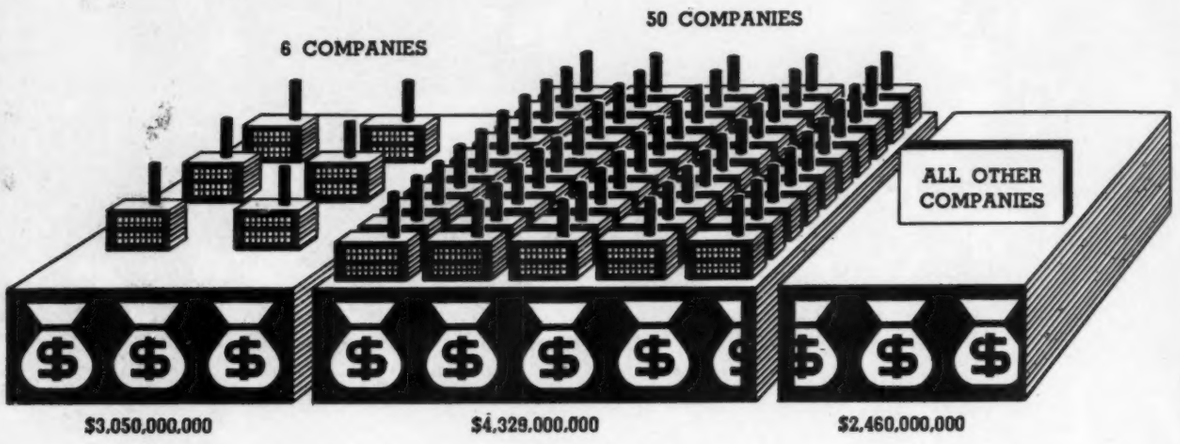
Defense clinics also will come to the fore. An example worthy of imitation is the New York clinic (described in the Check List, Item 11, and pictured on this page). Later defense goods "showcases" may be set up with typical items on display.

What can the individual manufacturer do, not only to help his own company but also to help industry and the defense effort generally? For one thing, try to avoid paying scalpers' prices for materials. Secret speculation is not only costly to the purchaser, it also thwarts price control and undermines economic stability.

For another thing, join enthusiastically in all proposals for conservation, reclamation, and substitution of critical materials. Report any discoveries you may make in these fields promptly to the Conservation Section of OPM.

What are the individual company's

TRY FOR A DEFENSE CONTRACT — PRIME OR SUB



Of the $9,839,000,000 of prime contracts awarded during the first year of defense, 6 companies received 31.5 percent. These 6 and 50 others received 75 percent. These contractors are rapidly becoming overloaded with orders, which improves the opportunities for other companies to secure either prime or sub contracts.

chances of getting defense business? There is no rule. The answer depends on specific circumstances. Some companies, no doubt about it, face an impossible situation. It is a fact that a former high OPM official, who hurried home to put his own business to rights, hit a stone wall in his hunt for defense contracts. Yet his search was about as exhaustive as it well could be, covering every item in the Check List and some more besides. He finally went to Washington where, naturally, he was able to interview officials who seldom have time for such callers. But the government already had ample sources for the defense products he proposed to make. And that was that.

Still, the fact remains that some 60,000 contracts in amounts of $100,000 or less will be let directly this year, to say nothing of bigger prime orders and the vast amount of subcontracting that will be spread through industry. Conversion of facilities is a reality. Business machine and battery plants are making bomb fuses, sewing machine plants are making automatic pistols, printing equipment plants are making telescopes, and so forth.

No manufacturer can call himself "out," therefore, until he has probed his prospects fully. Especially if he has machine shop facilities.

All manufacturers deserve a better-coordinated reception from the procurement departments of the government—which may come in time. Yet procurement officers have their side of the story. They contend, and rightly, that many non-defense companies were ducking defense business before the shortages set in. Moreover, one top defense official, himself a businessman of note, declares that in six out of ten cases that he studied personally, the only obstacle that stood between the prospective new contractor and an order was price.

What about "contact men"? Defense business agents are beginning to appear on the scene in large numbers. There is little hint of champagne salesmanship or "gratuities," but the fees that these men charge for a straight selling job are often extremely high.

Some of these agents unquestionably are doing a keen, legitimate job of analyzing product capacity and ferreting out government markets. In their wake, however, come lesser gentlemen who affect an air of mystery, pocket fat retainers, and display nothing on the ball at all. It is hard for a prospective client to distinguish between the breeds.

At best, the "contact man" adds to the cost of the defense effort. If he collects $50,000 on a $1,000,000 job, he probably makes more than anyone else concerned. And when he gets results, he has probably done no more than the average manufacturer could have done for himself by diligent and intelligent study of his prospects.

Scarce Materials

Ratio of civilian demand to civilian supply

Aluminum	15 to 1
Alloy steels	2 to 1
Chromite	3 to 2
Copper	5 to 2
Cork	10 to 1
Lead	1 to 1
Manganese	3 to 2
Mercury	3 to 2
Mica	5 to 3
Nickel	2 to 1
Nitrates	8 to 7
Plastics	3 to 2
Rubber	10 to 7
Steel plate	3 to 2
Steel, other than alloy or plate	10 to 9
Tin	3 to 2
Tungsten	2 to 1
Zinc	3 to 2

Other materials, actually or potentially scarce, include magnesium, brass, antimony, burlap, manila fiber, tapioca, ilmenite (a paint ingredient), silk, jute, vanilla, spices.

"Butter to Guns" Check List

PULL OUT

"Butter to Guns" Check List for Manufacturers

★ The non-defense manufacturer, faced with materials shortages due to priorities, has these three approaches to consider:

1. Try to stay in the present line of business.
2. Try to find lines utilizing materials not affected by priorities
3. Try to "get in" on priorities by getting defense business, by subcontracting, or by entering lines allied to those that enjoy civilian preference rating.

★ The following check list is NOT a guaranteed solution to specific problems.

★ Nor is it an infallible guide through the mazes of government agencies that confront the individual.

★ Quite possibly a major new government agency will be dedicated to these particular problems. Its creation may be announced between the time this list was compiled (August 25) and the time you read it. Even so, some time will pass before such an agency can be organized for effective action. Meanwhile it may pay to check this list.

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1. Keep up with events in industry and government

Information, in industry as in war itself, is of first importance, especially in today's confused, fast-changing situation. Key information sources, varying in value with local circumstances, are: (1) manufacturers' associations, industrial divisions of Chambers of Commerce, or both; (2) trade associations; (3) business magazines; (4) engineering and technical societies; (5) the officers of local banks; (6) daily newspapers; (7) business associates and friends.

These groups will play a recurring role in the suggestions set forth elsewhere in these pages.

2. Explore all sources of supply

The shortage of materials for non-defense products may be purely local. The assertion of a single supplier that he is out of stock and that no stock is available elsewhere need not always be taken at face value. Frequently the needed material may be found in the stocks of nearby suppliers or among those in other cities where, perhaps, the demand is less.

Here trade, industrial, and business associations can be helpful. An inquiry, addressed by them in the member company's behalf to their correspondents in other cities, may turn up unsuspected sources.

3. Anticipate shortages, try to find substitutes

"Over the desk of every top industrial executive and every designing engineer should hang a list of materials in which shortages have occurred or are expected," says a leading OPM conservation official.

Substitutions are coming to the fore—rubber for corks, glass for metal, plywood for galvanized sheets, and so forth. Industry is working diligently and with some success to devise them, despite the dismaying danger that shortages may develop in the substitutes themselves. The automotive industry has cut out nickel and reduced to less than half its use of copper, chromium, and aluminum.

OPM's Production Division now has a Conservation Section, with subsections on substitutions and reclamation. It is aided by advisory committees from the National Academy of Science. Again, the manufacturers' and trade associations, business papers, and engineering societies will help to keep the individual abreast of developments in this field.

4. Redesign to eliminate or reduce critical materials

Recent events are accelerating industry's evolutionary tendency to simplify and conserve. Henceforth, the design features that simply supplied "sales arguments" for products will be shoved into the background. Redesign has strong devotees in Washington. Donald Nelson, OPM Purchasing Director, has taken a pronounced personal interest in pushing the trend. He believes U. S. production capacity could be increased 25 to 35 percent by elimination of unnecessary types, styles, grades, and sizes from the run of civilian goods. Nelson has put the spotlight on the long-established Division of Simplified Practices, Bureau of Standards of the Department of Commerce. This and OPM's Conservation Section will yield much useful data in future as will all regular information sources and also the new OPM and OPACS industry committees, about which more later.

5. Look for non-defense products that can be made with readily available materials

A hungry consumer market awaits both the standard types of civilian goods and new *items* as well. If one can think of products utilizing unrestricted materials, this might be a good time to risk a little venture capital in a new line. Presumably the established competitors in the new field will have their hands full with the bigger market.

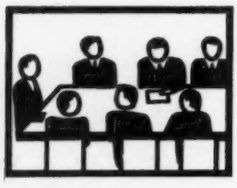
As for new items, war invariably stimulates invention of all sorts. This will include new product ideas and the revival of old ideas that weren't practical before. For information: trade groups and publications.

6. See if a genuine "hardship" appeal can be made

Does a shortage of a relatively minor amount of material threaten a shutdown and consequent unemployment? There is no fixed set of rules for dealing with this situation. Yet the government has made, and will undoubtedly make more, concessions to manufacturers who are lucky enough to present their cases in the right way to the right people.

In general the test of a "hardship" case is: Does a very small requirement for a material that is not too hopelessly critical threaten unemployment for a large number of workers? If so, help might be given by OPM—Priorities Division or perhaps the OPACS Civilian Allocations Division. If the plea is presented through a labor or labor-employer group, it might also enlist the influence of Sidney Hillman's OPM Labor Division. "Hardship" allotments are frequently made, by the way, to help companies bridge the period of re-organizing for defense work. Here the Defense Contract Service (see Point 12) might help.

7. Follow activities of government-industry committees



This is partially but importantly related to Checking Point Number One ("Keep up with events"). And it is at least marginally connected with most of the major problems of the defense situation.

These committees—there are three major types—are, in fact, likely to be *the coming big thing* in the defense industrial picture. Type One is the OPM "big committee" (e.g., the Automotive Defense Industry Advisory Committee—with its Passenger Car and Truck Subcommittees). Type One committees cover the big, basic industries and are addressed primarily to production problems and priorities.

Type Two is the Defense Labor Advisory Committee, formed by the Hillman office in industries more or less parallel to the Industry Committees and including labor representation. These tie in with the Type One committees and advise with them on problems affecting labor supply, labor welfare, industrial harmony.

To the extent that Priorities Division decisions affect civilian allocations and also result in labor dislocations and unemployment, the OPM committees (Types One and Two) naturally have bearing on the current plight of the non-defense manufacturer. But he finds representation also in the Type Three committees now being formed by the Civilian Allocations Division of OPACS. Through these the rationing of materials available after defense needs are met will be conducted.

Still tentative, still exploratory, still new, these OPM and OPACS committees have not yet frozen into their final functional pattern. Nor can they until the disputed jurisdictional boundaries of OPM and OPACS are defined by the President.

But it is already evident that the committees will mean much to all manufacturers, giving them a voice in matters of policy and affording a fruitful source of information on conservation, substitutions, conversion, subcontracting, and the like.

It is important for manufacturers to follow the news of industry committee activities in the publications available to them. It might pay also to keep in touch with some nearby members of the committees. The rosters are available through the OPM's Bureau of Clearance of Defense Industry Committees.

8. Find out what's wanted for defense

Those who do not already own one, should obtain a copy of the Army Purchase Information Bulletin. This booklet lists all Army and Navy Field Procurement Officers, together with the items of equipment they buy. It is a good starting point for a study of things that a company can make or can arrange to make with some conversion of facilities. Those who have definite questions to ask, can visit the Field Procurement Officers and confer with them. Or write to them. To secure a copy, write to the Purchase Information Section, Purchase and Contractors Branch, Office of the Assistant Secretary of War, War Department, Washington, D. C.

By all officials—not only in the armed services and OPM but also in the big prime-contracting companies—FACTORY is asked to urge prospective bidders to do *a selling job*. Again and again, they say: "Try to state your case in terms not of what you have *got* but what you can *do*." Most of these officials admit that the new bidder is apt to get an unintended "run-around," to be kept waiting, to be shunted unwittingly to the wrong places. "Unless you have shown all the persistence you would in your attempts to crack any other big, new customer," they say, "you cannot be sure that your plant has no place in the defense picture."

9. Keep after prime contractors in the local district

Everyone knows pretty well which companies hold major defense orders, yet may have missed some of them. Check with local manufacturers' and business associations, the headquarters of one's trade group.

To conduct a systematic campaign, the manufacturer might (1) analyze his facilities and prepare a general "what you can do" presentation, being careful to list machines and describe the closest tolerances to which they can work—both with and without the addition to, or adjustment of, existing equipment; (2) circularize the prime contractors—either addressing the company officers already ascertained or simply addressing the company itself. The prospective subcontractor should be prepared to follow up the circulars by calling in person or sending a representative.

Here again, persistence is urged. Officials are the first to admit that in dealing with some large prime contractors, as in the case of the government itself, the problem is finding not only the right company but the *right man* in that company. The companies are trying hard to simplify this problem, are setting up specially assigned departments. Officials emphasize the need for complete data as a means to prompt action.

10. Join in or take the initiative in community movements to spread defense work

The already famous York Plan of the York, Pa., Manufacturers Association, is the number one example. In Pittsburg, Kan., recently, the Tri-State Manufacturing Association set itself up as a prime contractor, took an order for $1,500,000 worth of shells, and found facilities for the job among its members.

Individual managements can make themselves the moving spirit in such plans locally. This is part of the approach urged in the OPM subcontracting handbook. "First," one official suggests "ask yourself if you think you are big enough to take on a prime contract. If the answer is No, ask yourself who in your district could possibly do so. List such firms, approach them, try to get them to join forces on a job."

Another example of the possibilities of cooperative contracting—this one initiated by an alert contracting officer—is the Cleveland Ordnance District "mother hen" case (described in FACTORY's National Production Issue, August, 1941, page 77.)

11. Attend "defense clinics" if it is at all possible

What, one may ask, *is* a defense clinic? In New York recently, hundreds of manufacturers swarmed through the grand ballroom of the Hotel Astor, stopping at desks marked Curtiss-Wright, General Electric, Baldwin Locomotive, and so forth. At each desk, a representative of the company concerned. On the wall behind him, a lettered sign proclaiming the sort of machine facilities he wanted to enlist.

There were 52 such desks in all, and at least 500 visiting manufacturers stopping to look at blueprints, examine sample parts, talk it over. For the prime contractors, a widening list of secondary producers to help them speed up output for Uncle Sam. For the prospective subcontractors, a month of exploration and prospecting telescoped into a day—and for some of them actual business on the spot.

This particular clinic was staged by the New York State Department of Commerce. The clinic idea will be more widely practiced throughout the country. Watch for announcements of clinics in the press and in business and trade asscciation publications.

12. Get in touch with the local Defense Contract Service

The Defense Contract Service is a branch of OPM which has recently been raised to the status of other chief OPM divisions, such as production and purchasing. Its one job is to aid in every possible way to spread defense work through industry.

New and still getting organized, the DCS has opened offices in the Federal Reserve Banks of principal cities. They are designed to maintain liaison between procurement officers, prime contractors, potential subcontractors, and other federal and state agencies in the local field. (See list on reverse side.)

To all who can handle defense business the DCS is there to see that they get it and to see them through. It will try to help in every way from arranging for technical advice and financial assistance to helping obtain priorities on materials—once a contract has been placed. The DCS has been known to intervene with a state highway department to get suspension of loading requirements to permit passage of a truck carrying an important machine from a prime contractor's plant to a subcontractor's plant. On one occasion it persuaded the police to waive "blue laws" for weekend work.

DCS officers warn, however, that their service is new, and their staffs and facilities are still growing. They expect the individual to do all the selling and hunting he can on his own hook.

Eventually DCS will have 36 district offices. (See list of existing branches on back of Check List.)

In addition, the various State Defense Councils are forming Production Committees to push subcontracting. The State Defense Councils have urged the opening of additional DCS branches. Plus this some of the state groups plan to open similar offices in cities where DCS is not represented. Inquiries concerning these can be addressed to the Governor of your state, State House, State Capital. The inquiry should find its way to the proper hands.

13. Watch the preference ratings granted to certain types of non-defense industry

"B" ratings are being given to makers of such things as railroad cars, pipe-lines, repair and maintenance equipment, hospital supplies.

Some of these manufacturers in the local district may be potential sources of subcontracting business. Subcontractors will share chances of getting preference.

Another suggestion—a good many holders of large prime defense contracts are said to be subcontracting much of their regular non-defense work. Presumably they have some reserves of materials with which to supply secondary producers.

14. Consider naming a specialist in the company to make a close study of the whole problem

Most large-scale defense producers have already set up liaison departments to work with their many-sided big new customer, the government. The appointment of company executives to study the priorities question alone has been recommended by the Priorities Division of OPM.

The same idea might well be carried over into the non-defense manufacturer's attack on the defense transition problem. This Check List will have done its job if it does no more than bring home to the reader the manifold complexities of the job. To its full-time study might well be assigned a seasoned executive—one perhaps combining the persistency and imagination of a first-flight salesman with the analytical ability of a research engineer. In some cases, the appointment of an executive committee has been recommended.

If You Decide to Go to Washington

For those who feel that the answer to their problem lies in Washington, FACTORY has winnowed out a few tips that may prove helpful. See reverse side of insert

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If You Decide to Go to Washington

"I defy any manufacturer to go to Washington and get anywhere!" exclaimed a New England industrialist in a *New York Times* interview. Washington, at best, is a maze likely to baffle any visitor. Yet some manufacturers, having exhausted every local possibility, may still seek their needles in the capital haystack.

Here, then, are a few clues, nothing more, to possible sources of assistance on the problems of non-defense industry. Bear in mind that the units of the defense administration are constantly changing—in function, personnel, and even location.

1. What is one starting point in Washington for those who seek to sell to the government?

The *Department of Commerce* has set up a *Service and Information Office* (Room 1060, Commerce Building) to steer prospective bidders, if possible, to the right purchasing agencies. It suggests (a) that manufacturers be prepared to propose a specific product; (b) that they try to carry on preliminary negotiations in the field before coming to Washington.

2. Where should "hardship" appeals be addressed by manufacturers to whom a small quantity of critical materials might mean the continued employment of a large number of workers?

Address Joseph H. Weiner, Associate Administrator of Civilian Allocations, *Office of Price Administration and Civilian Supply* (OPACS) 2501 Q Street NW (Room 209, Republic 5050, Ext. 642).

In some cases, one might also try the *Priorities Division of OPM* which maintains Priority Specialists in charge of the various commodities and industries. These specialists are too numerous to list here, but information concerning them may be obtained by addressing the office of Samuel S. Stratton, Technical Consultant to the Director (Room 5714, New Social Security Building, Republic 7500, Ext. 726).

3. Where can one get information on conservation, substitution, and salvage of materials?

The *Office of Production Management* (OPM) has launched a *Conservation Section*, headed by R. E. McConnell. His office in the New Social Security Building (Room 4625) will develop and disseminate information on conservation, substitution, and salvage methods applicable to entire industries.

Chief of the *Substitutions* Unit of the Conservation Section is E. J. Hergenroether, to whom specific inquiries on substitutions should be addressed. This unit plans to set up subdivisions relating to the principal critical materials. (Also Room 4625, New Social Security Building, Republic 7500, Ext. 2568.)

Manufacturers who have made discoveries in conservation, substitutions, and salvage which they believe to be of value to the defense effort should notify Mr. McConnell or Mr. Hergenroether of their findings.

4. Where can one apply for information regarding defense industry committees?

Address the *Bureau of Clearance of Defense Industry Advisory Committees*, headed by Sidney J. Weinberg, New Social Security Building. (See Point 7, in Check List on reverse side.)

5. Where can one look for ideas on new products, not necessarily defense products, which a non-defense manufacturer might enter?

It might pay to subscribe to the *Official Gazette* of the *Patent Office*, published each Tuesday. This contains news of all patent applications except those of a secret (i.e., defense) nature. Subscription, $16 yearly. Address U. S. Patent Office, Washington, D. C.

Another source might be the office of Mr. Hergenroether (Item 3, above) who is OPM's liaison with the National Inventors Council.

6. Where can one obtain information on re-design and simplification of products?

A special simplification section is being set up in the *Division of Purchases of OPM*. For the present, C. L. Warwick, consultant of this division, is heading up this work (New Social Security Building, Room 5326, phone Republic 7500, Ext. 3155.)

This section will maintain liaison with another source: *The Division of Simplified Practice* of the *Bureau of Standards*, headed by E. W. Ely, Room 353 Industrial Building, 'phone Woodley 1720, Ext. 260.

7. Assume that attempts to obtain subcontracts locally have failed—perhaps because district offices are too distant or not fully organized—where else in Washington might a manufacturer seek guidance?

The *Defense Contract Service* (See Point 12 in Check List) will play a primary role. If dislocations of labor or unemployment are paramount factors in the problem, it might pay to try the *Labor Division* (headed by Sidney Hillman) of *OPM*. These two units will operate in close concert on this problem.

Headquarters office of the Defense Contract Service is that of its chief, Robert L. Mehornay (Room 5326, New Social Security Building, 'phone Republic 7500, Ext. 3155). In the OPM Labor Division, address Eli Oliver, Associate Advisor in Labor Relations (Room 5070, New Social Security Building, 'phone Republic 7500, Ext. 3155). In the OPM Labor Division, it might pay to see J. Douglas Brown, director of Hillman staff's Priorities Branch (Room 5709, New Social Security Building, Republic 7400, Ext. 586). The DCS and the OPM Labor Division are expected to cooperate vigorously on farming out procedures, especially since the new ruling which requires that prime contractors must agree to subcontract a definite percentage of each job.

The Defense Contract Service

A KEY AGENCY IN THE SUBCONTRACTING PICTURE

District Offices and Officials

(See Point 12 in "Butter to Guns" Check List on reverse side)

NOTE: Address communications to the Defense Contract Service, *in care of the Federal Reserve Bank* at the addresses in the accompanying list.

Those who write or visit Defense Contract Service should present photographs of plants and as much of the following information as possible:

1. Number of employees.
2. Number that could be employed on a one-shift basis, a two-shift basis, and a three-shift basis.
3. How many shifts now being worked, and length.
4. How many it is possible to work with available labor supply.
5. Whether a design and development department is maintained by the plant.
6. List of machines, by size, type, manufacturer's name and serial number, year built, and tolerances to which they will work.
7. Number of machine-hours idle per week at present (broken down by machines).
8. Adequacy of power sources, shipping facilities, etc.

Federal Reserve District	City	Federal Reserve Bank Address	Coordinator	Manager
1	BOSTON	30 Pearl Street	Albert M. Creighton	Edward V. Hickey
2	NEW YORK	33 Liberty Street	Robert T. Stevens	W. O. Crabtree
	Buffalo	270 Main Street	John T. Lenahan	*To be named*
3	PHILADELPHIA	925 Chestnut Street	Thomas S. Gates	F. W. Hankins
4	CLEVELAND	E. Sixth St. at Superior Ave.	George C. Brainard	Chas. Terry
	Cincinnati	Fourth and Race Streets	Clifford Wright	Clifford Schulte
	Pittsburgh	Grant St. and Ogle Way	Alex E. Walker	M. F. McOmber
5	RICHMOND	Ninth and Franklin Sts.	J. G. Holtzclaw	Robert R. West
	Baltimore	Lexington and Calvert Sts.	W. F. Roberts	G. W. Creighton
	Charlotte	110 South Tryon Street	Frank H. Cothran	Francis E. Field
6	ATLANTA	104 Marietta Street	Frank H. Neely	W. C. Cram, Jr.
	Birmingham	Eighteenth St. and Fifth Avenue North	Edward Lee Norton	L. E. Geohegan
	Jacksonville	Church and Hogan Sts.	George W. Simons, Jr.	Chas. C. McCubbin
	Nashville	228 Third Ave. North	Arthur J. Dyer	W. G. Whitsitt
	New Orleans	Carondelet and Common Sts.	A. B. Paterson	R. E. Judd
7	CHICAGO	230 S. LaSalle St.	Wm. Homer Hartz	Thos. S. McEwan
	Detroit	160 Fort Street West	Clarence Avery	Warren H. Clark
8	ST. LOUIS	411 Locust Street	Harry B. Wallace	F. J. McDevitt
	Little Rock	Third and Louisiana Sts.	Charles L. Thompson	Alfred M. Lund
	Louisville	Fifth and Market Sts.	Charles W. Allen	Prentiss M. Terry
	Memphis	Third and Jefferson Sts.	Jesse P. Norfleet	Arthur M. Field
9	MINNEAPOLIS	73 South Fifth Street	Roger Shepard	H. C. Timberlake
	Helena	Park and Edwards Sts.	J. E. O'Connell	R. E. Towle
10	KANSAS CITY	Tenth St. and Grand Ave.	Kenneth A. Spencer	R. W. Webb
	Denver	17th and Arapahoe Sts.	Wm. L. Petrikin	Clyde C. Hartzell
	Oklahoma City	226 West Third Street	Fred Jones	Wm. H. Carson
	Omaha	1701 Dodge Street	Eugene McAuliffe	Arthur Walker
11	DALLAS	Wood and Akard Sts.	Chas. R. Moore	A. J. Langford
	El Paso	351 Myrtle Avenue	W. R. Blair	L. A. Wilke
	Houston	Texas Ave. and Caroline St.	R. Lee Blaffer	I. M. Griffin
	San Antonio	Jardin and Villita Sts.	*To be named*	P. E. Locke
12	SAN FRANCISCO	Sansome and Sacramento Sts.	R. C. Force	W. M. Hale
	Los Angeles	Tenth and Olive Sts.	W. S. Rosecrans	H. M. Craft
	Portland	Sixth and Oak Streets	*To be named*	S. A. MacEachron
	Salt Lake City	S. Temple and E. State Sts.	*To be named*	J. M. Leisner
	Seattle	Second Ave. and Spring St.	U. M. Dickey	F. C. Bold

Johnny, the hero, and Mary, the heroine, join with cast in singing "We All Belong" just before the grand finale

Play Tells Company Story

A chance for employees and "brass hats" to meet, an opportunity to explain company policy to workers and their families, and an evening's entertainment with overtones of improved employee relationship

EDWARD J. LUSH, Public Relations Department, Carrier Corporation, Syracuse, N. Y.

IN THESE TRYING TIMES when employee loyalty is so vital to continued operation of industries and fulfillment of defense contracts, it is significant to witness a refreshing approach to better corporation-employee relations through a policy of streamlined employee enlightenment.

Characteristic of all industrial enterprises, Carrier Corporation has its problems to solve—those pseudo-barriers of class distinction to break down, imaginary restrictions that seem designed to cramp the style of certain individuals, mind-made mysteries about corporation's cold-blooded attitude toward workers as mere machines, and the countless other headaches that make a large manufacturer's row a tough one to hoe.

Not Just a Cog

Said Carrier's president, J. I. Lyle, "Each employee in this organization is entitled to be treated not just as one of the gang but as an individual, worthy of getting a living wage and an opportunity to voice his own ideas about things that involve him. He should be made to feel that he has a definite purpose in the scheme of things and that he is not just a cog in a big piece of machinery that makes the wheels of industry go round. His job has dignity and security. He should know these things. I should like to sit down and talk to every man in this plant, to give him this viewpoint of his importance to us."

An employee enlightenment program that would get these thoughts across was therefore undertaken, and a director appointed. A big order, indeed, but not such a tremendous obstacle that rolling up the sleeves and trotting out the midnight oil couldn't handle it.

How to give the necessary facts the proper attire so that they would be received favorably? How far to go in presenting the things that seemed important to the "brass hats?" How much of the information outlined in Mr. Lyle's objectives could be left out

(Continued on page 156)

No one can talk shop at a moment like this—or feel superior either. A good time was had by one and all

Historical facts were amusingly presented. Costumes typify the time when air conditioning was young

Foremen "Eat Up" This Work-

Better work, safer ways, increased production, decreased waste are results of a course that taught foremen to watch for simpler job methods

S. L. WANSKY, Industrial Engineer, The B. F. Goodrich Company, Akron

TEST AND PROTECT THREADS-MOTOR SUPPORTS

Old Method

LEFT HAND	RIGHT HAND
Carries support aside	Reaches for next support
Releases support	Grasps support
Releases to front to grasp next support	Carries support to front
Waits for support to be brought to position	
Grasps support while inspecting	Turns to inspect support and releases
Turns to inspect	
Holds support	Reaches for nut
	Grasps nut
	Carries nut to support
	Tests bolt with nut
	Carries nut to next bolt
	Tests bolt with nut
	Reaches to grasp support
	Grasps support
Helps turn support	Helps turn support
Holds support	Releases support
	Carries nut to bolt
	Tests bolt
	Carries nut aside
	Releases nut
	Reaches for protectors
	Grasps protectors
	Carries protectors to support
	Places protector on bolt
	Moves to next bolt
	Places protector on bolt
	Reaches for support
Helps turn support	Grasps support
Holds support	Helps turn support
	Releases support
	Carries protector to bolt
	Places protector
	Carries protector to bolt
	Places protector
Total operations 5	19
Total transportations 2	15
Total holds 4	
11	34

Over-all time of cycle governd by right hand - 34 motions
Average number of frames per cycle - 429
Average time - 0.429 minute

When it is necessary to design automatic or semi-automatic machines for a definite purpose, you probably have qualified designers to do the work. When it is necessary to install a new process or new equipment, your engineers are probably capable. These are "big jobs," and no doubt you are well prepared to increase production by such means. But how about the little jobs, those that last a few hours, a day, perhaps three or four days? How about the production that has been delayed for some reason, and shipment must be made by 6 o'clock tonight? How about the products that are annually changed in design to meet requirements of new models, and do not justify permanent allocation of equipment and floor space?

In other words, how about the job order department? If your departments have similar problems to a num-

Simplification Course

TEST AND PROTECT THREADS-MOTOR SUPPORTS

New Method

LEFT HAND		RIGHT HAND
Carries support aside	○	Reaches for next support
Releases support	○	Grasps next support
Returns to front	○	Carries support to front
Grasps support	○	Holds support
Turns to inspect	○	Turns to inspect
Carries support to table top	○	Carries support to table top
Releases support	○	Releases support
Reaches for nut	○	Reaches for nut
Grasps nut	○	Grasps nut
Carries nut to bolt	○	Carries nut to bolt
Tests bolt	○	Tests bolt
Carries nut to bolt	○	Carries nut to bolt
Tests bolt	○	Tests bolt
Asides nut to table	○	Asides nut to table
Releases nut	○	Releases nut
Reaches for protectors	○	Reaches for protectors
Grasps 2 protectors	○	Grasps 2 protectors
Carries to bolts	○	Carries to bolts
Places protector	○	Places protector
To next bolt	○	To next bolt
Places protector	○	Places protector
Grasp support	○	Holds
Total operations	12	10
Total transportations	10	10
Total holds		2
	22	22

Over-all time of cycle governed by either hand - 22 motions
Average number of frames per cycle - 258
Average time - 0.258 minute

ber in our mechanical goods division, the operating effectiveness of labor and tools depends upon the foreman, who is the "on-the-job engineer."

In these production units it is the foreman's responsibility to determine what tools are to be used, set up the job, and see that the operator performs in the proper manner.

Previously, intensive courses in motion study and motion time analysis had been given to our time study men, engineers, and designers, with the view of providing those people with additional tools to permit better performance on their jobs. The results of this training have been better designed equipment and more effective layouts. However, this training took care of the "big jobs" only and to a large extent tended to neglect the "little ones."

To meet this need, it was decided to inaugurate a course in work simplification for foremen, because it is the foreman who is in closest contact with the job and the worker, and who knows best the difficulties surrounding the work. We decided to feel our way along, and start on a small scale. Therefore three classes were organ-

Summary—Test Motor Supports

	Old Method	Revised Method	Diff.
Total No. of Motions	45	44	
No. of Motions Controlling Time/Cycle	33	22	11
Ave. Time/Cycle (From Picture)	.43 min.	.26 min.	.17 min. (39.5%)

Principles Involved

Unbalanced Changed to Balanced Operation

Long Holds Eliminated From Left Hand

Hands Move Simultaneously in Equal and Opposite Directions

Cost of Equipment for New Method $0.00

Net Savings $270 per Year

ized with seventeen men in each group. Included were all the shift, floor, and departmental foremen and the general foreman in the molded goods division; two men from the bindery in the print shop; four men from lathe cut goods; four men from the de-icer department, as well as the general foreman from that and the hard rubber division.

Since these men were a small part of our total supervisory group, it was explained that they were not selected because they were doing a poor job, but to help them do a better job if possible; also, because they represented departments with various volumes of production, and the number of operations involved would lend themselves ideally to a work simplification program of this kind.

Not the Instructor's Job

They were told also that the instructor was not to be the chief job-improver, but the force behind the movement. The specific improvements were to come from their own heads, developed from basic ideas presented in class.

It was emphasized that the intent was not to sacrifice quality or safety in trying to find lower cost methods, but that, as a result of this type of approach, there would probably be times where the quality would be actually improved and the work made safer for the operator.

"Entree"

Several objectives were established to aid in making the job improvement program effective. These were to train foremen to:

1. Recognize ineffective operations or motions.
2. Think in terms of simple devices and gadgets, not intricate designs.
3. Look for the utility value of every movement or group of motions.
4. Use what he has to the best advantage before advocating changes.
5. Become what could be called a "baling wire engineer."
6. See the fatiguing parts of various operations.
7. Sell himself an improvement idea first.
8. Sell the worker the same idea and see that it is performed exactly right.
9. Have the viewpoint that every job as it is now being performed, is wrong.
10. Feel that the smallest idea is a big one.
11. Realize that improvements don't just happen, that someone must suggest them.
12. First look for the good in suggestions before finding fault with them or turning them down.

"Main Course"

How were these objectives achieved? Rather than detail what was included in the course, I shall explain how the material was presented, and the highlights of reactions we received. Perhaps the best way to do that is by comments on each meeting.

Meeting No. 1

The course was introduced to the foremen with a discussion of its need. The men seemed to receive it enthusiastically. One of the first questions asked, however, was whether or not they were to be tested at the completion of the course. We had not intended to give a test, but a direct answer was evaded by saying:

"If I told you that a test was to be given, you would start worrying about it, and make the goal of this training course the passing of the test. If I told you a test was not to be given, then you would probably not work so hard, and fail to get the maxi-

A BETTER WAY—INSPECTING FISHER STRIPS

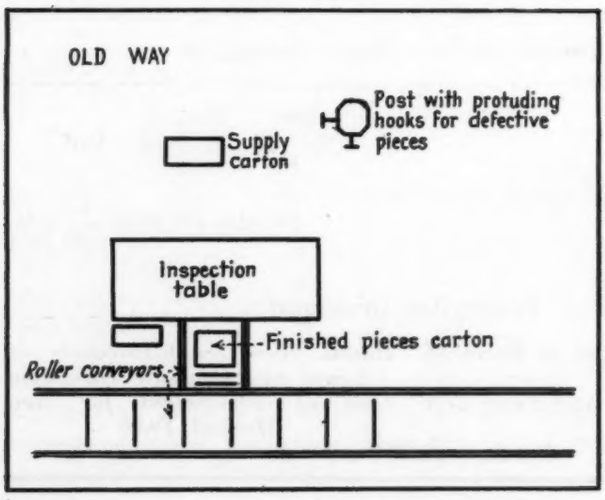
Mr. Wilbanks, Dept. 7515 foreman, enrolled in the motion study class, has suggested an improved layout which is now in effect.

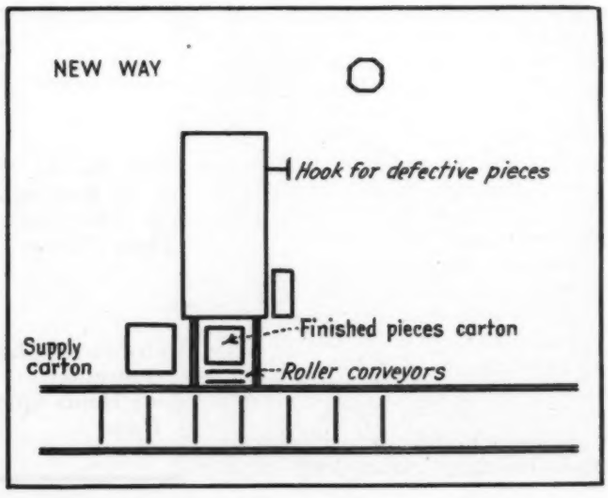
Under the old way, the operator turned 180°, obtained the strip, turned back to the table, inspected and trimmed, and then asided the strip by means of a long reach across the table into a carton. A walk of 30 feet was necessary to aside a defective strip.

Under the new way the operator gets the next strip as she asides the one inspected. Long turns and reaches are eliminated as well as long walks to aside defectives.

Below is listed a comparison of the standards:

	Old	New	Savings	%
Inspect Trim & Pack.....	110.0	106.0	4.0	3.6%
Inspect Bad Channel.....	77.0	68.0	9.0	11.7%
Inspect Splice Failure.....	24.0	31.0	11.0	26.2%





mum amount of good from the course."

This statement seemed to close that issue. The men displayed mild interest in history and development of motion study.

Meeting No. 2

After proper explanation and illustration, the foremen were asked to construct a process flow chart and diagram of some habitual domestic activity, such as cutting the lawn, getting dressed, etc. Generally they were quite surprised to see how these tools made them realize the number and ineffectiveness of the motions involved. Most of them devised an improved method for their respective operations.

Quite a bit of literature was handed out in this meeting, and many of the men were somewhat appalled at the idea of having to read it. A number of questions were asked as to when they were going to get the time to assimilate all that information. Relief was evident when they were told that all material would be covered during the one-hour conference each week. A number of good-humored derogatory remarks were made about the instructor's applying motion study principles, when the literature was distributed piecemeal. They never got another chance. The men seemed to like the idea of working in class.

Meeting No. 3

Movies (16 mm.) were shown of both the old and new methods of a bolt-and-washer assembly (obtained at University of Iowa Summer Management Course). The detailed story was distributed together with the operation analysis.

The purpose of this meeting was to instruct the foreman in making an operation analysis. A great display of interest began to appear at this point, even though there were one or two questions as to the length of the course. A toaster problem, involving the job of toasting three slices of bread both sides in an old-fashioned two-sided toaster, was presented (obtained from the same source), and an analogy was made to a limited order on a piece of equipment. The solution made it possible to point out that sometimes added motions helped increase production. The problem provided some entertainment, as well as an excellent chance for the men to construct an operation chart. As a matter of fact, it was later learned that one of the men carried the solution into his home and made a bet that he could toast three slices of bread quicker on a similar old-fashioned toaster than could be toasted on a newer model. He won the bet.

The incident indicated that the men were starting to think of motion study outside the conference room.

Meeting No. 4

Before presenting the program, a survey had been made of some of the represented departments, and a number of jobs were selected that had good possibilities of being improved. Movies (8 mm.) were made of the old way, the job was improved, and pictures were made of the better method.

At this meeting a loop film of the old method of testing a motor support was presented (see page 58), for the purpose of constructing operation charts as an aid in recognizing ineffective operations. There were 45 motions in the operation, but most of the foremen could see but 18 to 20. When the others were pointed out, they really began to sit up and take notice. The enthusiasm for this way of working on a departmental problem in class was apparent.

Suggestions were made for improving the job, and in a number of instances the foremen wanted to spend some money for devices and foot-operated jigs for simplifying the work. A study of the characteristics of the product revealed the needlessness for additional equipment, and it was stressed that we must first exhaust the possibilities of improving the job simply from a motion standpoint.

Meeting No. 5

Here the men were required to analyze the loop of the improved method of testing the motor support (see page 59), and they had little trouble in recognizing the motions involved. They were surprised at the possibilities of motion analysis. The foreman in charge of this particular

(Continued on page 160)

Private Pensions and Social Security

JOHN B. ST. JOHN,[1] Chief, Actuarial Section, Bureau of Old-Age and Survivors Insurance, Social Security Board, Washington, D. C.

RECENT STUDIES of the development of private pension plans made by the National Industrial Conference Board[2] and the Industrial Relations Counselors[3] indicate the continued rapid growth of such plans in the manufacturing industries. A large proportion of existing plans are now specifically designed to supplement the federal old-age and survivors insurance system, either by modification of an existing plan or by establishment of a new one.

Prior to the passage of the Social Security Act in 1935, it was recognized that the old-age insurance system would have a substantial effect on private pension plans. The payment of federal old-age benefits would increase the retirement income of pensioners under private plans, unless the terms of those plans were modified. The collection of taxes for the federal system would increase the difficulty of finding funds for the maintenance of private plans. Therefore, some adjustment of a large proportion of private plans now in force in this country was to be expected.

The first attempts to deal with this problem directly occurred during the discussion of the Social Security Act before its passage. The so-called "Clark amendment," which never became law, attempted first to set up a system of exemption for any private plan that provided benefits equivalent to those of the federal plan. Subsequently, a system of transfer of credits and funds for employees leaving a private plan was considered. The pattern of the federal plan differed so substantially from the normal pattern of private plans that no practical system of exemption or transfer of credits could be developed. The 1939 Amendments to the Social Security Act further changed the pattern of the federal system, making it even

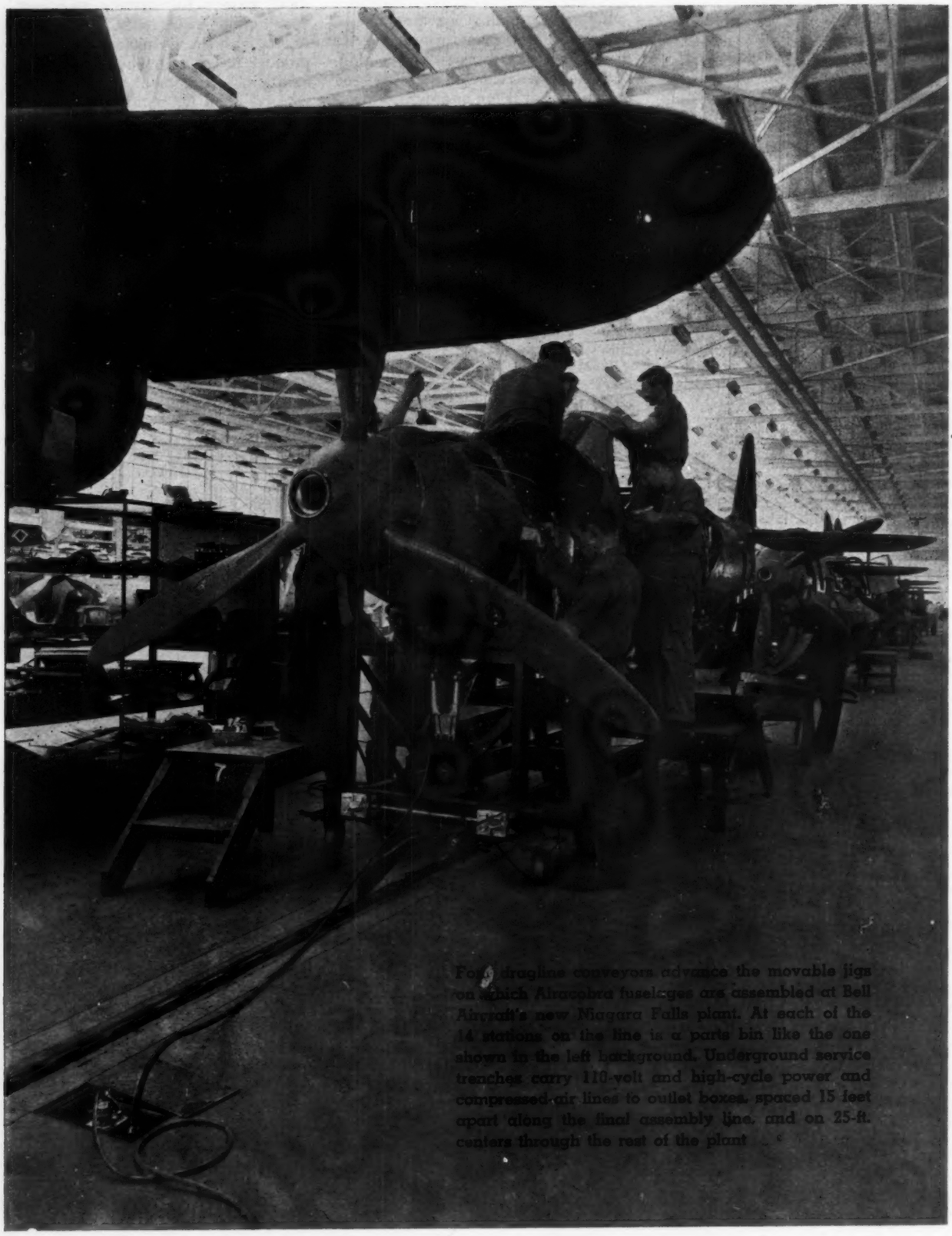
(Continued on page 161)

[1] The opinions expressed in this article are those of the author and do not represent the official views of the Social Security Board.

[2] "Coordinating the Company Pension Plan with the Amended Social Security Act"—*Management Record*, Vol. II, No. 5 (May 1940) pp. 53-59.

[3] Murray Webb Latimer and Karl Tufel. "Trends in Industrial Pensions" Industrial Relations Monograph No. 5, 1940.

Aircraft Plant Is Built Around



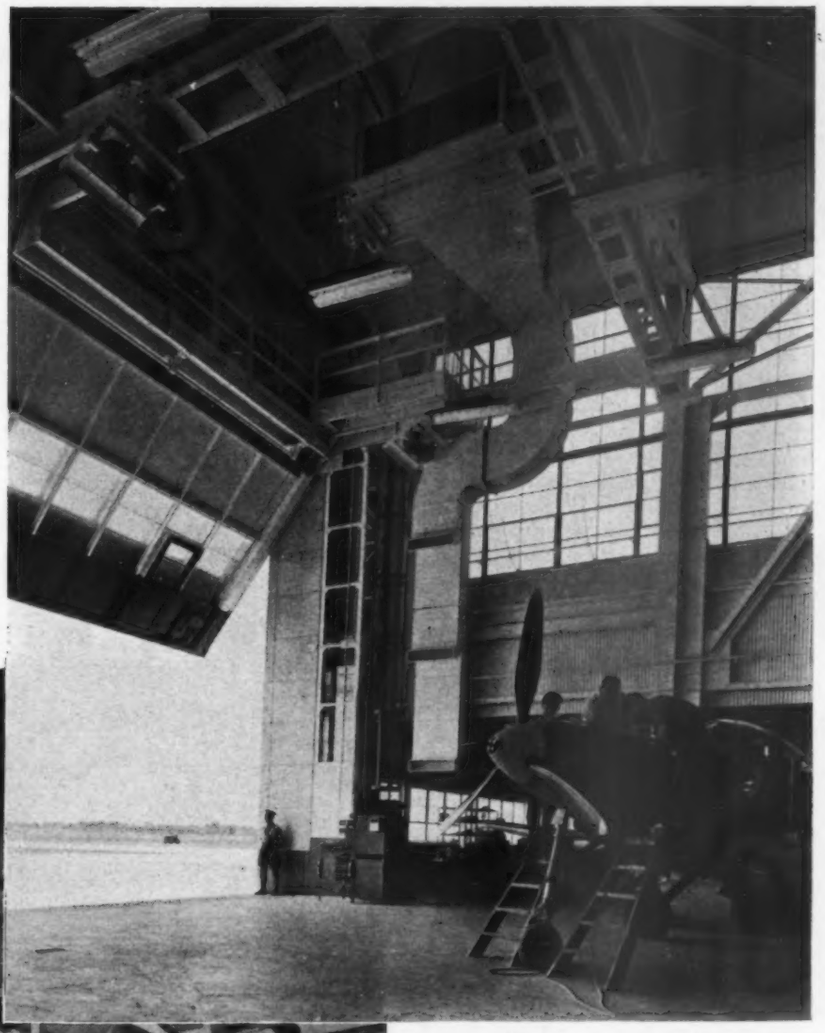
Four dragline conveyors advance the movable jigs on which Airacobra fuselages are assembled at Bell Aircraft's new Niagara Falls plant. At each of the 14 stations on the line is a parts bin like the one shown in the left background. Underground service trenches carry 110-volt and high-cycle power and compressed-air lines to outlet boxes, spaced 15 feet apart along the final assembly line, and on 25-ft. centers through the rest of the plant

Mechanized Assembly

EVERY FACILITY for efficient workmanship and speedy handling has been built right into the Niagara Falls plant of Bell Aircraft Company.

Devoted entirely to assembly, prefabricated parts from the company's Buffalo plant are delivered by trucks. Parts bins are transferred directly from truck to subassembly stock cribs in each department.

Four main assembly lines extend through the center of the plant in a high bay with 30-ft. clearance below roof trusses. Most subassembly work is concentrated in four 50-ft. monitor bays. Cranes and monorails facilitate movement of parts and subassemblies in each department. Each subassembly reaches the final assembly floor, already painted, on its own specially designed dolly. And all parts come together in the 200-ft. hangar area, where, as completed Airacobras, they are made ready for their final inspection and first test flights.



Almost ready to go out through the 195-ft. canopy door for its first flight test. Special unit heaters, one on each side of the huge door, keep workers comfortable. From all sides come the parts, by crane, monorail, and dolly, to be finally assembled in 200-ft. hangar area

Airacobras are painted right out on the assembly floor. Paint is sprayed on in an open booth; three fans move 45,000 cubic feet of air per minute, draw fumes from the paint spray down through the floor grille, and exhaust them through the roof

Conveyor Pays Out in a Year

Less congestion, simpler record-keeping, greater safety, better control are among the advantages gained by installing one not-too-expensive conveyor

R. H. DOWD, Factory Superintendent, Dennison Manufacturing Company, Marlboro, Mass.

IN OUR MARLBORO PLANT, where we manufacture paper boxes, the space required for a bulky product, and a gradual change in our type of work from a small-order business to long runs, forced us to take steps to relieve congestion and facilitate the movement of work through the plant.

We have been transporting partly finished goods between floors, and finished goods to the shipping department, by elevator. Last year we installed a conveyor to move all fiber shipping cases containing finished merchandise from the producing departments to the shipping room. The results have greatly exceeded our fondest expectations.

The advantages we sought to gain, and the actual benefits that have been derived from this conveyor system, can be stated briefly as follows:

1. Relief of congestion in the producing departments, particularly in the area around the freight elevator.

2. Reduction of indirect workers such as movemen.

3. Simplification of records of delivery from producing departments to shipping room.

4. Improvement of elevator service for incoming freight and interdepartmental traffic.

5. Better housekeeping and improved safety conditions.

6. Better control of work in the shipping room.

The conveyor itself is simple, consisting of two open spiral chutes constructed of boiler plate, and gravity roller conveyors on the shipping room floor, which are approximately 150 feet long with 24-in. rollers. The chutes are centrally located in each of the two departments where the bulk of our boxes are finished, and the loaded fiber cases are fed into these chutes as fast as packing is completed. Bottoms are closed, top flaps interlocked. The cases are propelled by gravity down the spiral chute, and then on to the inclined roller conveyor that leads to the shipping room area, where everything is checked and sealed.

From the sealing stations, the flow of work is regulated by hand levers which release the cases. An electrical contact device is attached to a slightly raised roller at the bottom of each spiral chute, so that a red telltale light automatically goes on at the mouth of the chute when the conveyors are loaded to capacity. This is the signal for the loaders to stop releasing cases from the upper floors. As soon as the sealers have removed a sufficient number of cases and the line is clear, the telltale light snaps off.

The arrangement in the shipping room for sealing cases, and inserting dunnage where necessary, has greatly simplified this work. Instead of taking cases from trucks and putting them on the bench, the men who do this work stand at the lower end of the conveyor which is at this point just the right height for them to work to the best advantage. They seal the tops and bottoms of the cases and place them on skids, on which they are moved either to temporary storage or to the truck or freight-car loading platforms.

An automatic counter, attached to each conveyor, records the number of

Finished boxes and loaded fiber cases ride down spiral chutes to the shipping room. A red signal light shows when conveyors are loaded to capacity, snaps off automatically when line is clear

Standing at the end of the conveyor system, men seal cases and place them on skids. Former method was to lift the boxes from trucks, put them on benches, thence to skids. Two handlings are saved

cases handled in any given period. Incentive rates for the sealing operators will be installed presently. Under previous conditions the work could not be sufficiently standardized to make this possible.

Our method of handling the continuous flow of cases before this installation, considering the bulk and the number of pieces handled, appears now to have been quite impractical and inefficient. The cases were set up and the bottoms stapled according to the requirements of the producing departments. This work was done in the shipping room, and the bulky fibers were delivered to the departments by elevator.

Large Cases, Small Elevator

Our freight elevator is about 10x8 feet, and, although satisfactory for a small-order business, finally became entirely inadequate for our present production. The made-up fiber cases, after delivery to the producing departments, required a great deal of space, and it was difficult to have the proper supply, at the right time, at the various locations where orders were being packed. With our present plan, these cases are delivered to the departments knocked down, or flat, taking up a minimum amount of space. They are set up as needed by the girls who do the packing.

The even flow of finished work as it is now delivered by the conveyor, eliminates congestion in the shipping room, particularly at the end of the day, reducing the necessity for overtime each night to cover late shipments. Several hundreds of fibers are handled on the conveyor each day. It will accommodate cases from a minimum of 15x10x6 to a maximum of 29x14x20.

Before the conveyor system was installed, a shipping clerk in each department made out a delivery record to accompany every truckload of boxes delivered by the elevator to the shipping room. On long runs, lasting for several days or several weeks, as many as 50 to 60 individual shipping records were necessary.

Under the new plan, practically all this clerical work, and consequent chance of error, has been eliminated, because the record of deliveries is made at the sealing stations in the shipping room. Previously we had a set of delivery records in the producing departments and receiving records in the shipping room. Under the present arrangement, the one record, easier to keep and more accurate, serves our purpose. This is possible, of course, because the actual time required between the release of cases from the producing department and their receipt in the shipping room is so short.

Naturally our elevator service has been greatly improved, and we now have no problem whatever in taking care of the large volume of incoming raw materials and other freight, as well as the movement of materials between departments. In general the housekeeping and orderliness at the area around the elevator on each floor is much improved, an important safety factor since the elevator is used at opening and closing times by employees. The congestion previously presented not only an untidy and unsightly appearance, but was also a definite accident hazard. Several minor accidents in the past few years can be traced directly or indirectly to the crowded conditions that prevailed.

One of the most interesting points in connection with this conveyor installation was our approach to the problem and our method of selling the idea to our company officials. Before we started, we saw visions of a very expensive change, which would mean considerable engineering and changes in our building. Now it

(*Continued on page 164*)

Carter Products, Incorporated

III—The Planning Department Hits a Snag

No use to plan production when sales pays no attention to schedules. No chance to cut costs when planning can't plan. Third in a series about a make-believe company whose troubles are real

JOHN H. HILL, Industrial Engineer, Bundy Tubing Company, Detroit

WALT SPARKS was having a busy day. Ed Peters had had three calls from him in the last 15 minutes, and now saw him coming down the aisle humped over, busy with his own thoughts, seeing nothing around him as he strode along, a sheaf of memos and orders in his hand.

"Now what?" thought Ed, as he directed one trucker to get a load of stock into the plating department, another to locate urgently needed material dropped some place and not to be found.

"Here's those orders I 'phoned to you last night. Are they finished yet?" was Walt's greeting.

"What the devil do you expect?" answered Ed heatedly. "You gave me those orders last night at 4.30 and it's now . . ." he turned around to glance at the clock . . . "Yeah, look at that! A quarter to nine the next morning, and you want to know if they're done." Finding no further words to express his irritation, he glowered at Walt as though Walt were responsible for it all.

Walt paid no attention to all this. He knew Ed had to blow off a certain amount of steam before anything could be accomplished.

"You're right, Ed," he said, resignedly. "I know it. I'm sorry. But it can't be helped. First thing this morning, Bates was on the 'phone, telling us their line was going to be down in a couple of hours if we don't get their order through—"

"Aw, nuts!" growled Ed. "The old baloney. They can't wait two hours and give us a decent break."

"Yeah," agreed Walt. "But you know how it is. After all, we've had this order for two weeks, and it was supposed to be shipped three days ago . . ."

"Yes," broke in Ed again. "And you know why it wasn't. Because for the last week we've been rushing through Chadwick stuff, which had to go on the same machine. They were in a hurry! Chase was in a hurry! *Everything* was rush!"

"He's pretty hot this morning," reflected Walt, fidgeting because of the delay in getting across what he had come downstairs for. He had to make six more stops like this, before he went upstairs again to resume taking messages from other rampant customers.

"Look, Ed," he pleaded, finally. "I know you can't help it, but neither can I. Where's the stuff now?"

"Just going into plating."

"Okay. Now here's an order for Colson's that must be shipped a week from today, sure. BM has given us another two days to get out those 10,000. But they're making dire threats if we slip again. I'll be seeing you."

Walt turned on his heel and headed for the shipping room. Ed Peters turned to his desk and disgustedly slammed down the new orders, slammed the order file shut, and turned around to three operators, standing idle.

"What do you want?" he asked the first, irritably.

"Another job," said the operator, briefly.

"What's that sticking in your order slot there, a ham sandwich?"

(*Continued on page 166*)

Something wrong with planning—always something wrong. Never could take an afternoon off for golf—always something to ruin his day

Figure 1. Posting withdrawals and transfers from draw-out tickets to stock control records was formerly done by hand, was necessarily laborious. Now a machine is used that was specially developed to handle the job

Stock in Fifteen Places, But Control in One

Only 12,300 stockcards, one for each item, instead of the 92,000 needed if every item had a card for each stockroom and were carried in half of them. No more posting by hand. Machines to determine order points and economical re-orders

R. H. WILSON, General Service Manager, Bell Telephone Laboratories, New York

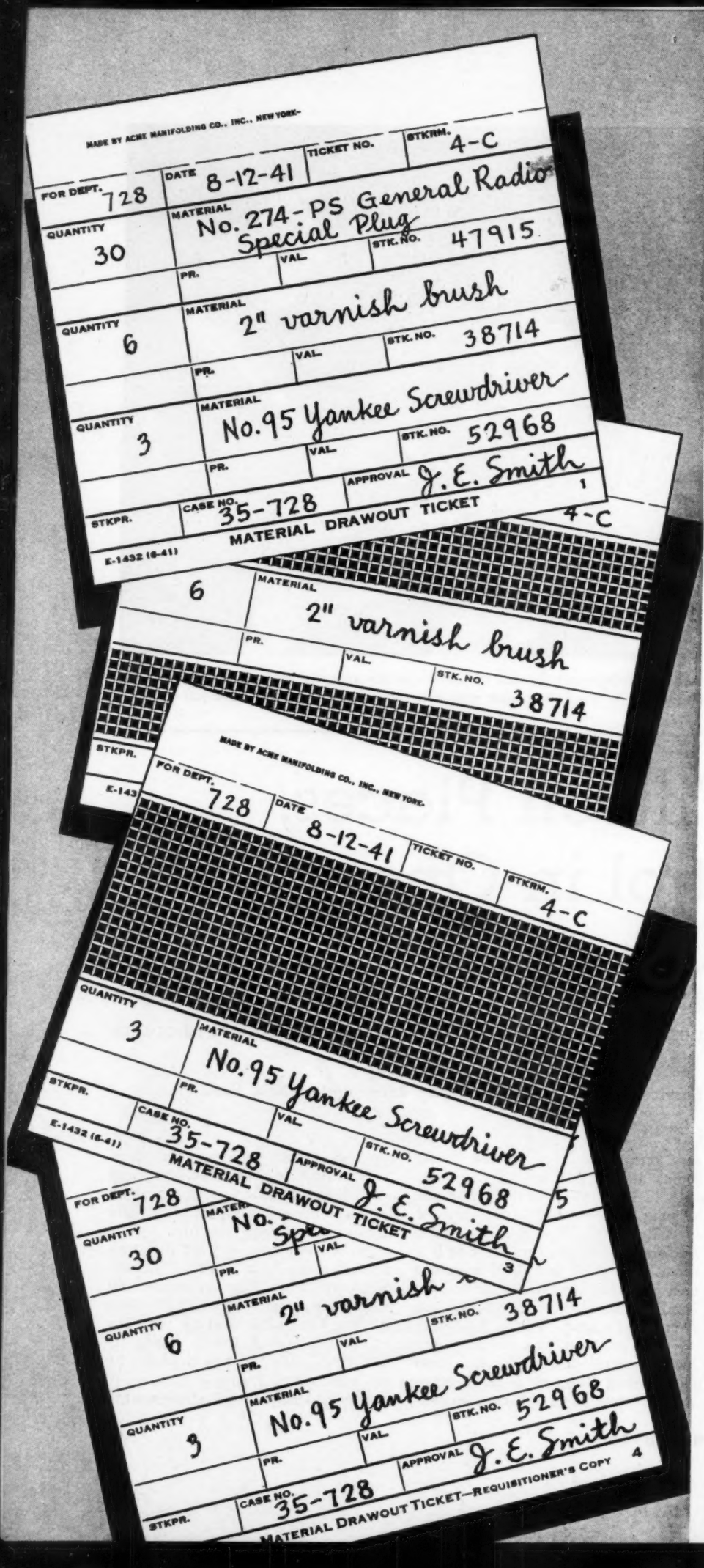
OUR STOCK CONTROL PLAN, as now set up, is the result of several years of development work. New methods and records have been introduced and special machines devised for posting draw-out records, determining the most economical amount of stock to order, and finding the minimum quantity at which stock should be re-ordered so that the out-of-stock conditions can be controlled economically.

If only one stockroom were concerned, the problem of keeping a record of its operation would be an easy one. There are fifteen stockrooms at the Laboratories, however, with 12,300 items, and it would mean keeping some 92,000 stock cards if every item had a separate card for each stockroom and were carried in half of them. The file would be an enormous one; in some cases we should have to handle as many as a dozen cards when re-ordering a stock item.

Until last year this difficulty was met by using one card for each item and posting the records in as many separate sections on this card as there were stockrooms carrying the item. This posting was done by hand and was necessarily laborious; it was done that way because until recently there has been no suitable machine.

At the beginning of 1940 the stock control group, the methods department, and the office equipment and development department of Western Electric Company, working with the equipment manufacturers, finally obtained the stock posting machine we are now using (Figure 1).

The first step in the stock control



operation occurs when an engineer obtains material from a stockroom by filling in a draw-out ticket (Figure 2). This ticket permits the withdrawal of as many as three distinct items. It is easily separated into the original and three copies; the first two copies are crosshatched so that only the second item is readable on one copy and the third on the other. The stock control group is thus provided with three separate tickets which can be sorted according to the stock number of each item. The remaining copy is returned to the person making the withdrawal.

A Number for Each Item

Each stock item has a number, and stock control record cards are filed accordingly. Draw-out tickets are sorted according to the first two figures of the stock number. The tickets in each section of the sorter are then placed in final numerical order. All the tickets of the same number—that is, for one stock item—are totaled day by day for each stockroom and entered on the master record card.

Transfers of material between stockrooms are also recorded. If one stockroom is low, stock is transferred to it from the one that the record card indicates can most easily spare it. Reorders are placed when the total stock has reached the minimum stock or ordering point. Entries, of course, are made when fresh supplies are received. The stock control card (Figure 3) carries in its left margin a continuous day-to-day inventory, which shows the total stock on hand in all stockrooms, distributed in various stockrooms as indicated.

While the stock control clerk is posting each card, she watches to see if stock should be transferred between stockrooms or if the ordering point is being reached. If so, the card is kept out of the file for action. Withdrawals are in red, receipts in black, and stock transferred is marked *TR*. A separate roll accumulates all entries and gives a sound method of checking the accuracy of all postings.

Each line gives date, number of withdrawals, and total units withdrawn. This information is essential in determining minimum stock or ordering points because the two fac-

Figure 2. Pull-apart arrangement permits easy separation of draw-out ticket into original and copies. Crosshatching makes second item readable on second copy only, third item on third. Fourth copy is kept by withdrawer

STOCK CONTROL RECORD

ACCOUNT 50-320-7330 — ITEM NO. 274-PS GENERAL RADIO SPECIAL PLUG (SILVER PLATED) — STOCK NUMBER 47915

ORDERING AMT. 500 — CONTROL STOCKROOM 4-C

ORDERING PT. 200 — REMARKS — UNIT PC-27 — PRICE 5.640

TOTAL BALANCE	TOTAL BALANCE	TOTAL BALANCE	STOCKROOM 4-C DATE	N	POSTING	BALANCE	STOCKROOM 9-C DATE	N	POSTING	BALANCE	STOCKROOM G.V. 13TH DATE	N	POSTING	BALANCE	STOCKROOM 3-C DATE	N	POSTING	BALANCE
762			MAY 16		450	450	MAY 16		38	38	MAY 16		87	87	MAY 16		28	28
742			MAY 21	2	20	430	JUN -4	1	06	32	MAY 23	1	16	71	JUN -7	1	08	20
704			MAY 23	2	20	410	JUN -7	2	16	16	MAY 28	1	08	63	JUN 12	3	04	16
661			MAY 28	1	30	380	JUN -8	TR	36	52	JUN -8	1	06	57	JUN 28	1	04	12
645			JUN -4	1	10	370	JUN 12	3	12	40	AUG -9	1	06	51	JUL -1	TR	20	32
621			JUN -8	TR	36	334	JUL -3	1	06	34	SEP -4	1	04	47	JUL -3	1	05	27
615			JUN 25	2	45	289	AUG 12	1	02	32					AUG 12	1	03	24
589			JUL -1	TR	20	269	AUG 21	2	08	24					AUG 21	1	04	20
514			JUL -3	3	30	239									AUG 29	1	04	16
508			JUL 11	TR	24	215												
501			AUG -9	1	20	195												
460			AUG 12	1	30	165												
442																		
416																		
373																		

BUILDING R DATE	N	POSTING	BALANCE
MAY 16		42	42
JUN 25	1	12	30
AUG 29	1	03	27
SEP -4	1	02	25
SEP 17	1	06	19

G.V. 10TH DATE	N	POSTING	BALANCE
MAY 16		26	26
JUN 28	1	02	24
JUL 10	1	06	18
AUG 29	1	08	10

6-B DATE	N	POSTING	BALANCE
MAY 16		51	51
MAY 28	1	05	46
JUN 12	1	06	40
JUN 25	1	18	22
JUL -1	1	04	18
JUL 10	2	12	06
JUL 11	TR	24	30

HOLMDEL DATE	N	POSTING	BALANCE
MAY 16		14	14
MAY 23	1	02	12
JUL -1	1	03	09

DEAL DATE	N	POSTING	BALANCE
MAY 16		26	26
JUN 12	1	04	22
AUG 12	1	08	14

Figure 3. Continuous daily inventory is kept for each item. Total on hand is shown in column at left, distribution by stockroom in other columns. Both withdrawals and transfers to other stockrooms are recorded

tors required are the average number of withdrawals during the restocking time and also the size of the average withdrawal.

When an item reaches the ordering point, the stock purchase card (Figure 4) is removed from the file. The information at the foot of the card shows the number of draw-out tickets and the total amount drawn out by months, as obtained from the stock control record card. This consumption information is used to determine the rate at which the item will move in the next few months. Once this is known, the most economical amount to order can be found from the ordering tables, which will be discussed later. Approvals for the purchase are then obtained, and the card is forwarded to the purchasing department for action.

The stock purchase card eliminates the use of a separate purchasing requisition for each re-order of stock, and is also of service to the stock control group because it carries a complete record of purchasing for seventeen reorders of stock.

Management is concerned with the

Figure 5. Most economical amount of each stock item to carry is found from tables that are mounted on rolls or on panels of stock control machine

Figure 6. Tables mounted on rolls show ordering points from running out of stock once a year to complete protection. Stock is kept at economical minimum

BELL TELEPHONE LABORATORIES INCORPORATED

STOCK PURCHASES

STOCK NO. 47915

ITEM PLUG

PURCHASING DESCRIPTION: NO. 274-PS GENERAL RADIO SPECIAL PLUG (SILVER PLATED)

STK. RM.	COST PER C	ORD. QTY.
4-C	5 64	500
UNIT: PC-27		ORD. PT.: 200
FLAM. MAT. MAX.		DATE
LEDGER CLASS.: 50-320-7330	AUTH. TO STK.: 11-23-37 C.T.C.	CARD: 1

STOCK RECORD NOTES

1 SUPPLIER: General Radio Company, 30 States St., Cambridge, Mass.

2

3 SUPPLIER

4

QUANTITY	ESTD. EXP.	DATE	APPL.	CKD.	SUP.	APPROX. COST	DELIVERY	FOLLOW-UP	BUYER	APPL.	ORDER NO.
EXPENSE APPROVAL					PRICE & TERMS						RECEIVALS
500	30 00	9/7/40		✓	1	30-	10/8	9/25	G.O.P. 9/8	L.R.S.	3196H 109 500
M. W. Redmond					@.6 00 per C net fob Cambridge Mass.						TIME 8x
500	30 00	3/11/41		✓	1	30-	4/13	4/1	G.O.P. 3/14	L.R.S.	2562V

TIME

CONSUMPTION INFORMATION

YEAR	S	1940	N	S	1941	N	S		N	S		N	S		N	S		N	S		N
JAN.		36	6		28	5															
FEB.		107	18		189	15															
MAR.		129	17																		
APR.		84	9																		
MAY		94	10																		
JUN.		200	33																		
JULY		186	29																		
AUG.		66	13																		
SEPT.		105	13																		
OCT.		43	5																		
NOV		44	4																		
DEC.		77	8																		
TOTAL		1166	165																		

Figure 4. Ordering point and quantity of items to be ordered appear in upper right-hand corner of stock purchase card. Number of draw-outs and total amount withdrawn are given by months at bottom of card

economical operation of stockrooms, but engineers are primarily interested in obtaining items promptly and in the desired amount. Consequently for each item there must be carried the most economical amount of stock comparable with its demand. The "out-of-stock" condition must be kept at a reasonable minimum. Since most of the items in our storerooms are staples and not subject to the vagaries of style and season, it has been found possible by mathematical studies to meet these conditions by a routine method.

For most items, only the operating factors of the stockroom have to be taken into consideration. They are the interest rate on money invested in stock, insurance, depreciation, obsolescence, and cost of placing stock orders. Rent does not have to be considered because our stockrooms do not change in size.

Under these conditions a simple table is all that is required since the most economical amount of stock to order is proportional to the rate at which the item moves. There are occasions, however, when other factors have to be taken into account provided none of them is in conflict with current governmental regulation. These factors are increasing discounts for larger lot purchases; various periods within which payment may be made; lower transportation rates on larger lot shipments; increase in the risk of obsolescence and depreciation as the amount purchased increases; the advisability of purchasing more than the normal amount when prices are rising and less when they are falling; grouping orders on a supplier to get a better price or to save money on transportation rates.

A table is required for each condition, and some of the tables are too large to handle easily. Also they soon get dog-eared and dirty. To overcome these handicaps and speed up their use, a stock ordering machine (Figure 5) was devised. The tables are prepared on one long scroll which is mounted in the machine on rollers so that it can be spun rapidly to bring the columns on the table selected adjacent to the associated information on the face of the machine. Strips of different colors at the top of the columns help to identify the tables quickly as the scroll is rolled. Other tables that are small and in continuous use are mounted on the cover panels of the machine.

To avoid exhaustion of the old supply before the new arrives, it is necessary to determine the amount of stock that should be on hand when fresh stock is ordered. This is called the ordering point; it depends on the

(Continued on page 172)

Foremen Are Seldom Psychologists

Simple rules, not involved psychological explanations, are what foremen need to help them get along with men, maintain discipline, keep production up and costs down

ROBERT N. McMURRY, Executive Secretary, The Psychological Corporation, New York

FOREMANSHIP TRAINING is sometimes regarded as a panacea for a variety of industrial ills. Its advocates believe that it should be particularly helpful in stimulating production, reducing employee turnover, and improving labor relations. What they do not always recognize, is that there are definite limitations in the capacity of the average foreman or supervisor to benefit from training of this character. This may best be illustrated by the experience of a large industrial organization in the Middle West.

This company was extremely anxious to improve the effectiveness of its supervisory staff. For this purpose, a series of ten group conferences, attendance limited to 20 at each conference, was arranged. The conferences were held at company expense and on company time.

Popular Presentation

Since the group's education was limited, the material was presented in as popular a manner as was consistent with sound teaching principles. Each discussion centered about some common situation that the members would be likely to meet in the course of their daily work. The various topics were illustrated with cases taken from their own and similar plants.

Particular attention was paid to such common problems as insubordination, failure to cooperate with new supervisors, arguments and rivalries between employees, and how to deal with "problem" employees. Discussions were held concerning the merits of leading or driving employees. Much consideration was given to an analysis of the qualifications of a satisfactory foreman or supervisor. The influence of such factors as feelings of insecurity, emotional maladjustment, and domestic difficulties on the employee in his relations to his job were gone into at length. Every effort was made to provide the foremen and supervisors with an insight into human nature that would enable them better to handle the problems that they might encounter in the course of their supervisory work.

The results of this program, taken as a whole, were disappointing. Approximately one-third of the participants could not be stimulated to take any appreciable interest in the topics being discussed. Of the entire group, probably not more than 10 percent ever made any actual and practical use of the material they learned.

In an effort to determine the reason for the program's lack of success, each of the participants was interviewed. These interviews made it apparent that there were several contributing factors.

To begin with, some of the older employees tended to resent the conferences. Many of them had been on their particular jobs for long periods, had always believed that they were doing their work satisfactorily, and felt that in some obscure fashion the series was a reflection on their executive ability. Hence, even though they did not know exactly what the discussions were to concern, they embarked on the conference work with a definite prejudice against it.

A second factor that was of the utmost importance was the participants' lack of desire to benefit from the material presented to them. Their attitude toward the course was essentially the same as their attitude toward their jobs. They felt that as long as they performed their functions with routine efficiency their obligation to their employer was discharged in full. They could see no reason why they should spend any effort to make themselves better supervisors or foremen. They regarded themselves as quite all right as they were.

Furthermore, many of them had their principal interests entirely outside of their jobs. Their work served simply as a means whereby they could obtain money to live and to indulge in their outside interests. One man was training to be an aviator. As soon as he could get his license as a flyer, he was planning to quit the company. Several were primarily interested in athletic activities after hours. A large proportion were concerned chiefly with which team would win the National League pennant. Consequently, for many the hour devoted to the conference became primarily a fine opportunity for mental and physical relaxation.

Perhaps the most important single factor in the failure of the series was many of the participants' inability to comprehend and deal with the concepts involved. Even though popularized, human relations remain fundamentally complex and abstract. Human relations problems have to be worked out in the head in every case.

Nearly All From the Ranks

This many of the foremen and supervisors experienced great difficulty in doing. Few had more than a high school training and many little more than elementary schooling. Nearly all of them had worked up from the ranks. Nothing in their jobs required them to deal with abstractions or work out complicated problems in their heads. They had never learned to perform intellectual tasks, and in a series of only ten conferences it was impossible to teach them.

The situation was complicated by the fact that several were not only inexperienced in mental work, but lacked the basic capacity to do it. Their work was routinized to a high degree. Consequently no premium was placed on the possession of intelligence by the incumbent. As a result, by a process of natural selection, many of these positions had come to be filled by persons of mediocre attainments. As one of the primary marks of intellectual inadequacy is an inability to deal with abstractions, several in the group were handicapped from the outset. This inability to grasp the content of the series gave

(*Continued on page 174*)

MANAGEMENT SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

MATERIALS HANDLING MOTION ECONOMY

Delivery Box Is Now Gravity Feed Hopper

HAROLD HART KROLL, Rubberset Company, Newark, N. J.

With the aid of a lightweight, adjustable-feed cover made of heavy canvas we convert regular stock delivery boxes for light-

weight parts such as rings, small stampings, and handles into gravity-feed hoppers. A slide fastener, the main feature of this box cover, is set in diagonally in order to regulate the flow of material and direct its course. A stiff wire is drawn through the seams of the flaps which extend from the top and sides of the cover. A coil spring adjusts the tension which is required to keep the cover firmly in place.

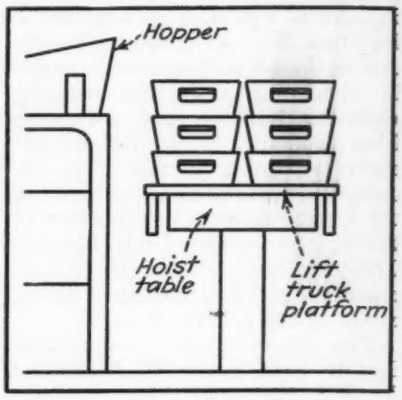
•

Hydraulic Lift Cuts Motion and Fatigue

PETER L. BUDWITZ, Meriden, Conn.

How a hydraulic lift is utilized to reduce motion and fatigue is shown in the sketch. The operation consists of lifting tote boxes and dumping the work they contain into the hopper of a chip separating machine. Boxes are delivered to the machine on a lift truck whose platform is loaded to the same height as the machine hopper.

Before the lift was installed, the work of the man doing the unloading became harder as the pile of pans was reduced, because he had to bend down nearer the floor to grasp the pans and lift further. The lift simplified the job, since the pans can be repeatedly raised to the level of the hopper as the pile of work diminishes. When a platform of work has been completed, the lift is lowered to the floor and another loaded platform set on it.



EMPLOYEE RELATIONS AND SAFETY

Wooden Blocks Prevent Accidents at Platform

JOHN MOORE, Bridgeport, Conn.

An incident that nearly became a serious accident brought home to us the need for providing against safety hazards around our truck loading platform. The platform is under cover and the runway slopes slightly away from it to take care of drainage. In winter, after the trucks come in, we let down the electrically operated doors.

One morning a large outside trailer

(Continued on page 176)

Management, How Good Is Your Control?

Ask yourself these questions to check up

12. SPECIAL AND RUSH JOBS

1. **Are many special jobs being brought into your unit? Too many? Where from?**
2. **Are special jobs analyzed to determine whether or not they are really urgent? Are non-urgent jobs refused? Are they placed in normal work flow?**
3. **Are rush jobs given priority? Are they analyzed to determine what caused them to become rush jobs, in an effort to cut down their number?**
4. **Are experimental jobs given priority? What machine are they scheduled over?**
5. **What instructions have you received about special, experimental, and rush jobs?**
6. **Do you give special and rush jobs special attention to see that they are handled with a minimum of interruption of normal flow?**
7. **Do you record handling procedures given special jobs, for future reference?**
8. **In assembling work, are you required to accept imperfect parts and do special work on them to maintain your production schedule?**
9. **Are special re-work jobs on imperfect parts made by another department, which salvage requests your department to do, refused if the work will interfere with your regular production schedule?**

Next Month: Interdepartmental Visiting

Prepared by HARDING PALMER, *Industrial Engineer*
Lockheed Aircraft Corporation, Burbank, Calif.

Forty-sixth in the Series of FACTORY MANAGEMENT and MAINTENANCE Plant Operation Library

PLANNING AND CONTROL IN SUBCONTRACTING

EDWIN A. BOYAN
Department of Business and Engineering Administration
Massachusetts Institute of Technology
Cambridge, Mass.

TWO POINTS STAND OUT CLEARLY in the present production situation throughout the country. First, certain general principles are evolving in relation to contracting and are emphasizing the crucial need for coordinative action by industry. Second, little definite technique has been advanced thus far to place these principles on an explicit basis.

One need—for farming out, or subcontracting—is well established. The required arms, equipment, and material will be sooner acquired to offset the advantage possessed by countries already mobilized for many years; the disruption of community life will be modified; and the problem of readjustment in a post-war era will be less severe. An important by-product will be the elimination of high fixed charges otherwise necessitated by the installation of new facilities.

But, however well established the need may be, when undertaking subcontracting the manufacturer naturally seeks the answers to several important questions:

1. Are there any prerequisites that must be satisfied before subcontracting can be successfully undertaken?

2. How can the prime contractor picture his future subcontracting needs in simple terms of quantity and delivery?

3. Where should the prime contractor turn in his own organization for executive and technical assistance for supervision of subcontracts, and how should this new division be organized?

4. How much "wet nursing" is essential in organizing and assuring satisfactory subcontracting production?

5. When the prime contractor is in a position to say that he has completed an entirely successful negotiation with the government for a contract, exactly what has he accomplished?

6. How can the working relation between prime contractor and subcontractor be visualized and simplified to afford maximum coordination and flexibility with minimum irritation?

An analysis of these problems provides the background for developing the necessary technique and control that are so essential to successful subcontracting.

1. Prerequisites of Successful Subcontracting

Before any organization can hope to attain satisfying results from subcontracting, it must put its own house in order. Production control and planning, cost analysis techniques, training efforts, materials schedules, tools, stores supply, budgeting, and other elements must be closely articulated and functioning efficiently. Until this is done, or at least in process of active fulfillment, it is difficult for a company to begin to think of subcontracting, much less be in position to consider adequately and accept a prime contract from the government. When a prime contract is accepted, the price stands and the delivery dates stand. With a poor background in developing a bid and an irregular method in carrying through the contract, many problems of a complex nature are bound to arise.

Many companies are therefore reluctant to invite prime contracts from the government, but again state they are willing to perform in the defense effort on a subcontracting basis. Even so they may well find it desirable to reorganize and modernize their management functions, for a prime contractor who has allocated work to them depends on reasonable costs and deliveries.

Probably the highest skill an organization can enjoy is the ability to forecast the requirements of the future. A successful enterprise *must plan ahead*, not in a general way, but in as great detail as possible. The further the forecasting can be perfected, the better. When there is a plan, and its progress is noted, attention can be concentrated on the obstacles to that plan, and then action taken to eliminate those obstacles. This is fundamentally sound management and applies

even more to the defense situation. There is greater need, now than ever, for looking ahead. It is necessary to plan for men, materials, and tools. Also it is necessary to determine the need for subcontracting and consequently the formulation of an allocation policy.

Sperry Gyroscope Company may well serve as an example of this forward-looking policy. Two divisions, the planning department and the sales department, are called upon to give a forecast in terms of orders:

1. In process of manufacture.
2. Entered but not started.
3. In process of negotiation, but not definitely cleared.
4. Potentially to be received.

The planning department furnishes the information for the first two items, the sales department for the latter two.

Forecasts were made for a year ahead. At present, plans are being worked out for making monthly forecasts. This in turn causes concentration upon the first two items, as the defense situation has created plenty of orders ahead.

Each forecast, as time goes by, goes through three phases: (1) Over-all; (2) negotiation; (3) actual procurement.

Phase 1 merely prescribes the general future need. The information is converted into the number of equipment-station man-hours of production required. (An equipment station is a group of similar machines.) Since the capacity of each equipment station is known, it is possible to determine the points where overloads exist. The next step is to determine new facility requirements, labor increases, and the possible allocation of subcontracting. At this time the planning department makes a survey of possible subcontractors and in many cases distributes educational or trial orders.

There is a regular system of negotiation between the sales and planning departments. For example, the sales department sends in notice of contract negotiation and tentative delivery dates suggested; the planning department in turn sees how the requirements fit in and submits approval or suggestions. Before a contract is definitely signed, as many as twenty communications may take place.

Liaison of this type has been found inescapably necessary. Hence, as more information on the orders in process of negotiation becomes available, the forecast enters Phase 2, and the corresponding production changes are noted and acted upon. In other words, there is the tendency more closely to fix where and how much the overloads on equipment stations are to fall. More definite action may be taken by requesting approved subcontractors to stand by and prepare for allocation of subcontracts. In Phase 3, upon confirmation of the contract, everything is thrown into gear, the specific production schedules are outlined, and work proceeds.

2. Simplifying Future Subcontracting Needs

The forecast and the corresponding production loads may be pictured most simply by means of a load chart, an application of the Gantt technique of charting, in which the situation respecting a definite period is clearly laid out.

Data for such a chart are obtained by conversion of the sales forecast—i.e., orders on hand plus expected orders—into the machine load in hours. Herein comes the need for good management in formulating standard times required to produce articles irrespective of whether they fall into the category of normal or defense business.

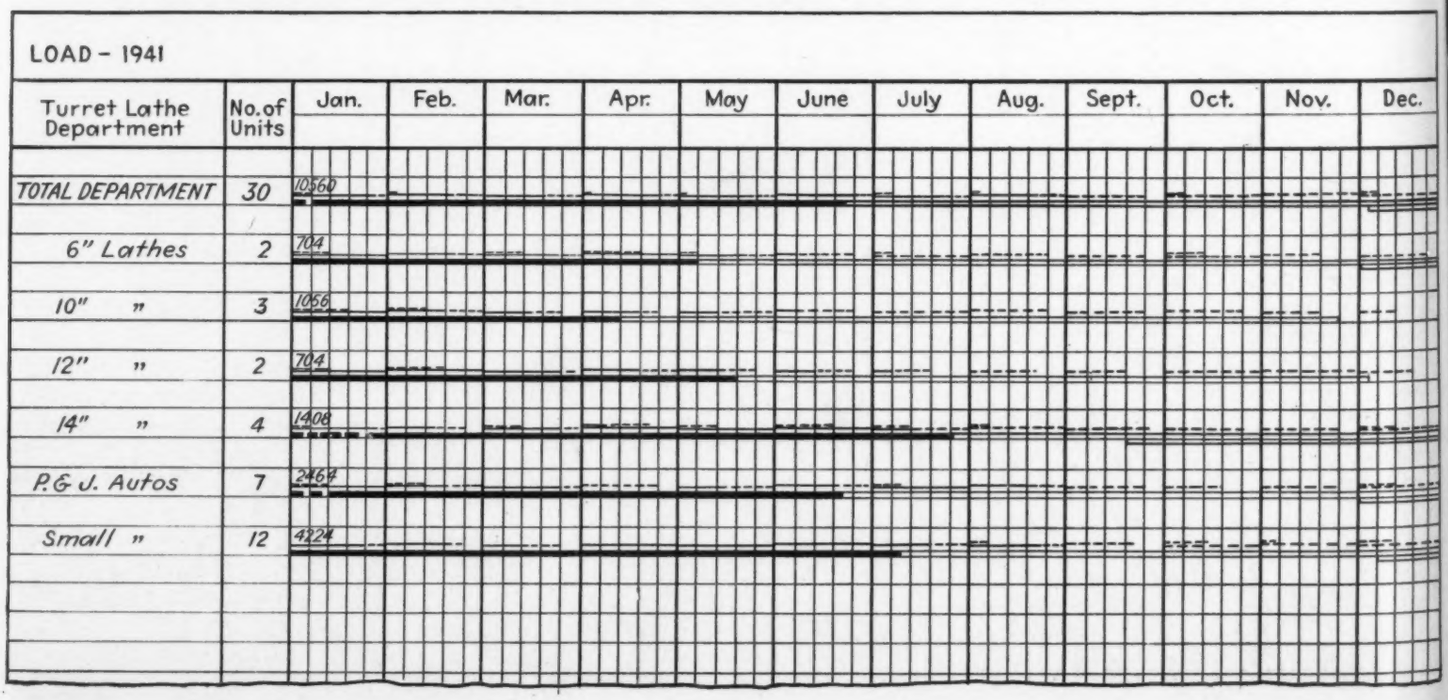
Figure 1 is the detail chart of the loads on the various equipment stations of one department, e.g., the turret lathe department.

In the column representing the first month, the figures indicate number of operating hours for each group. In the case illustrated, number of operating hours is based on two 8-hour-shift operation for 22 working days per month per unit. The proportion of total time of each group taken by orders already received, is indicated by a light solid line in each monthly space. Expected orders are indicated by a light dotted line.

For example, if the capacity of an equipment station is 1,000 operating hours per month and orders already received will take 800 hours and expected orders 400 additional hours, a light solid line is drawn through 80 percent of the space and a dotted line through an additional 40 percent of the space, thus:

The accumulative total on the date the chart is drawn is indicated by a heavy

Figure 1. What shall we subcontract? Load charts, departmental and for the whole plant, help visualize the work ahead. At points where capacity is shown to be exceeded, subcontracting can be used if no other alternative exists to take care of the need



solid line for orders on hand and by a hollow line following the solid one for orders expected but not received.

Totals of each department and eventually of the plant are then indicated by using heavier solid lines and wider hollow lines for accumulative totals. Hours required for orders behind schedule are shown by heavy dotted lines.

An immediate analysis of the situation can be made from the chart. For example, it is possible to determine:

1. Where the production labor force must be increased.

2. Where subcontracting may relieve the load.

3. Possibility of increasing the number of shifts.

4. What additional types of orders may be taken.

5. Types of orders to reject because of overload of existing facilities or inability to subcontract.

6. Increase of facilities for balanced plant operation.

On the basis of the data presented in load charts, the points where overload will occur may be strengthened largely through the use of subcontracting. Survey of the available subcontractors is made, educational and trial orders are executed, and the stage is set for the time when the demand will definitely arise. At periodic intervals the chart is revised as new information comes in and data become more definite. The graphic method cannot be excelled as a device to disclose possible choke points long before they happen. A subcontracting or defense production situation or difficulty cannot be solved immediately, especially during actual stress. It must be guarded against well in the future.

3. Organizing to Handle Subcontracts

After a forecast indicates the need for subcontracting, the next step is to develop a separate organization to handle this function. Subcontracting is rather simple in principle, but difficult in execution. The examination of potential subcontractors, their approval, and the allocations of parts and assemblies for manufacture result in the development of many individual problems and obstacles which must be attacked and eliminated by a special staff with distinct and separate responsibilities.

There should be no lessening of emphasis upon the subcontracting function, once it is the accepted policy of the company. As a distinct function and responsibility, it must have a proper person and head in authority, coupled with an adequate staff normally recruited from planning, purchasing, and design departments. At times employees and production divisions are particularly useful in acquainting subcontractors with special processing techniques. A typical organization chart is shown in Figure 2.

The subcontracting chief, a methods engineer with adequate mechanical experience and an ability to manage, is directly responsible to the planning manager for all subcontracting activity.* Under him he has three functional groups:

1. *Office.* This group takes care of all records, reports, surveys, and the progress of allocated orders. Among the records kept are the loads in subcontractors' plants so that the prime contractor may determine if further allocation is possible.

2. *Follow-up.* This group makes the rounds of the subcontractors' plants. If a plant is large, one man may be stationed permanently. Follow-up men are valuable, for in noting the progress of the order they locate obstacles and take action. Should the matter be beyond their control, they can immediately notify their chief, who in turn can secure some expert from the staff of the prime contractor.

3. *Methods.* This group is made up of time-and-motion-study men, trained in engineering methods and the manufacture of parts allocated to subcontractors. They are sent to the subcontractors' plants when an educational order or subcontract is negotiated. It is their job to educate the subcontractor, so that he may become a more efficient and capable producer.

Oftentimes it happens that a manufacturing company is not sufficiently large to have an extensive subcontracting staff like the one described in the foregoing text and illustrated in the accompanying figure. In that event, proper subcontracting activity may still be developed by choosing men who are sufficiently versatile to handle one or more of the minimum required functions—i.e., *office, follow-up,* and *methods.*

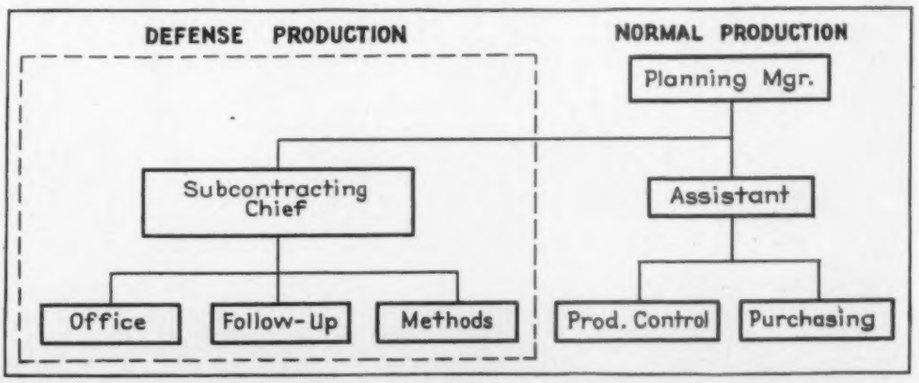
For example, a member of the proposed organization may be concerned with both maintenance of records and follow-up. Sometimes a period of training and supervision will be required to develop the necessary versatility. But the danger of ultimate "thinning" of the staff by many duties should be avoided because the neglect of some element may seriously endanger the progress of the educational program and eventual subcontracting relationships.

4. Wet Nursing for Assured Production

Once the policy has been formulated that subcontracting will be resorted to when overloads occur, the means must be taken to organize and secure adequate subcontracting facilities. It is inadvisable to "dump" blueprints and specifications upon an organization and tell it to go ahead and make the part. If the part is one for assembly in the prime contractor's plant, he runs a very real hazard, because delays will inevitably occur that may seriously jeopardize his own production schedule.

On the other extreme is the subcontractor who supposedly "knows it all" and insists upon being left alone. His promises are optimistic. Sometimes he is capable of fulfilling them. But it is better to be pessimistic and successful with what is promised, and it is sensible to start at

Figure 2. Obstacles are best attacked by a special staff with distinct responsibilities



*Sperry Gyroscope Company practice. In some other companies the subcontracting organization is directly related to the purchasing department.

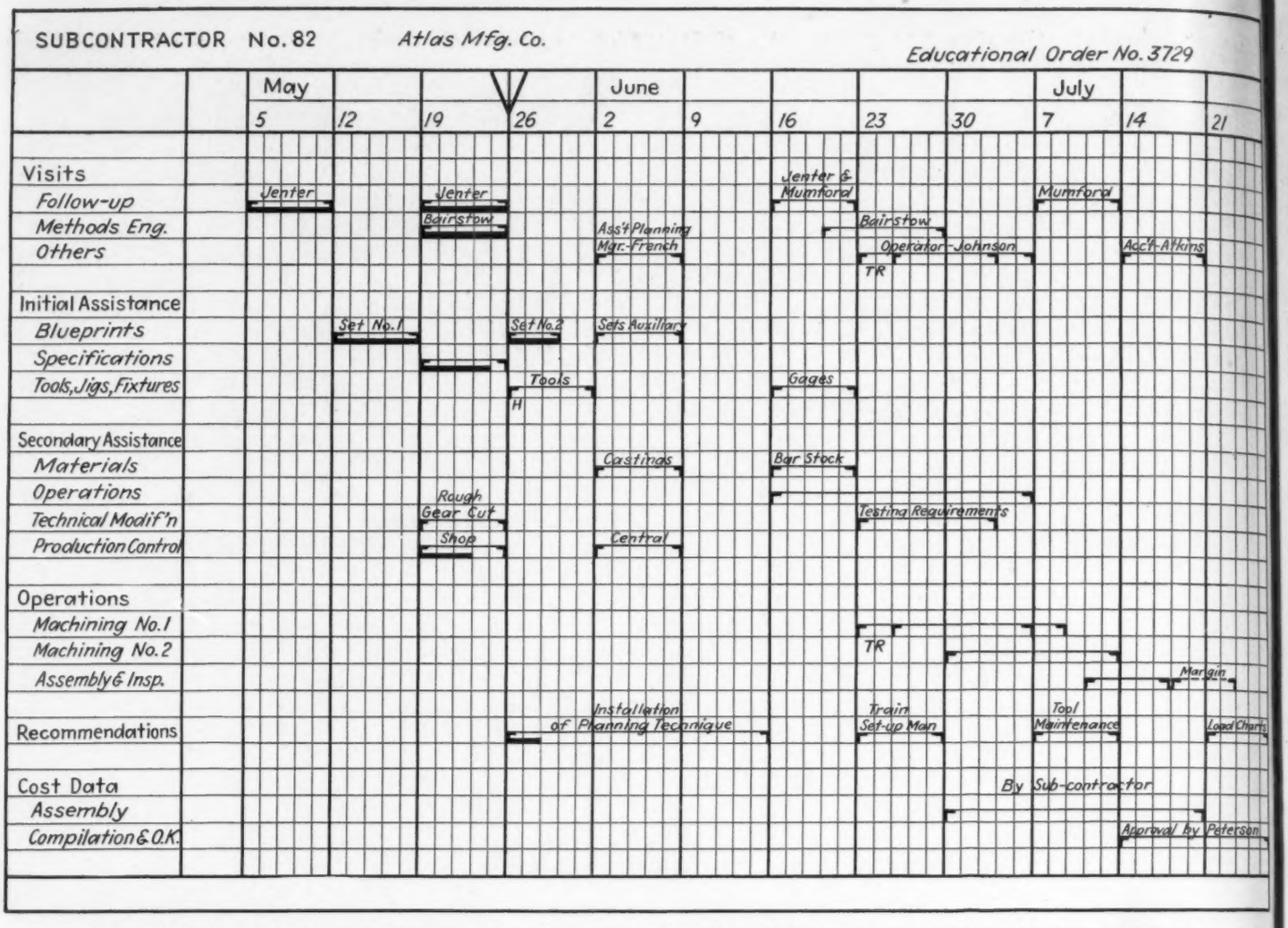


Figure 3. Schedule of events required to carry out an educational order. As progress of the schedule is followed up, obstacles to the fulfillment of the order are indicated. It is then possible to eliminate them through the right kind of corrective action

the "high-water mark" of knowledge. Although a prime contractor subcontracts a part, he nonetheless is presumed to know how to make it. Otherwise it falls into regular purchasing routine, as contrasted to subcontracting which is fundamentally the means for relieving one's own facilities. And in knowing how to make it by having gone through the trial-and-error process and having worked with it, there is no reason why the subcontractor should not start with the benefit of such knowledge as the prime contractor may have.

The organization of potential contractors and their subsequent education may best be initiated through the use of educational orders. A potential subcontractor is first surveyed as to his equipment and, what is often more important, his organization and management—that is, the state of his finances, the ability of the executives, and the skill of the workmen.

The trial order need not be for parts that will be made later under actual subcontracting conditions. Usually the orders are for parts to go into stock and embody machining operations that may prove to be, or are, overloads.

The special subcontracting division handles all the trial orders, which permits its men to enter the subcontractor's plant and verify the preliminary survey of the potentialities of the contractor for future business. It has been found necessary to make this personalized survey and review.

The Methods Engineer

The methods engineer arrives with all pertinent blueprints, specifications, route sheets, operation times, technical data respecting materials, heat treatment, finishes, and so on, and all tools, jigs, and fixtures to make the part. He reviews the data with the shop personnel receiving the order, answers all queries, and provides suggestions and ideas. In other words, his function is to educate the subcontractor's people to the best of his ability.

The Follow-up Man

A follow-up man then appears to note the progress of the work, to discover where obstacles occur, and to make recommendations. For example, the existing production control technique may be inadequate, in which case the methods engineer will suggest improvements. Perhaps other obstacles arise which are beyond his ability to eliminate. In such cases he may ask for the services of various specialists within the regular organization. It may be a product engineer to modify or explain specifications, a machine operator to indicate the set-up of tools, a specialized methods engineer to suggest layout or basis for time studies, or a toolmaker to recommend improvements in the toolroom for reinspection and maintenance of jigs and fixtures. In other words, all possible technical assistance is made available. The prime contractor should expect to give it.

Costs and Potentialities

Finally machine rates are calculated by carefully considering total burden charges and labor costs. Often a cost analyst is called into this phase of the work, and a conclusion is reached respecting a favorable rate to serve as the basis for future contract charges.

As a final element, recommendations are made to the subcontracting chief regarding the potentiality of the organization that received the trial order. This thorough examination may cause the contractor to be placed on either the excellent, good, or fair list. Perhaps he should not be utilized at all. In any case, when recommendations are made to the potential subcontractor, he must carry them out. Not until then will he be in position to receive further orders.

This is a costly process, but ultimate savings result in addition to other benefits. First, the prime contractor has effected a

personal relationship that is the key to good subcontracting. Second, he knows the costs, capabilities, and potentialities of a subcontracting unit to perform. Third, he has a standby capacity that can serve, provided he still maintains records of availability (best done by load charts) as a basis for negotiating future contracts.

The Progress Chart

Planning is required for the correct control of educational orders. First of all, planning on the basis of the forecast is needed accurately to determine the subcontracting potentiality that must be developed. Second, planning by the prime contractor in conjunction with the potential subcontractor is advisable in order to follow through correctly and efficiently on the progress of securing data, formulating recommendations, and eliminating obstacles.

Figure 3 shows how the Gantt progress chart is used for the detailed planning and control required* It enables one to see in advance just what is to be done and to compare actual progress with that foreseen. It helps to lay out the work so that a single person does not have too many things starting at one time. It helps to keep activities tied together and to make sure that every necessary step, in the logical sequence, is carried out at the right time. Finally, it helps both the prime contractor and subcontractor keep up to the program foreseen, and indicates to the subcontractor one of the less formal uses of the methods of planning control.

Preparation of the Chart

The technique of drawing the chart is flexible and should be varied to meet the needs of the individual case. It should be drawn on the first visit, showing the work foreseen during the next two visits and the interval between them. The chart may be revised during the second visit, but a new one should certainly be prepared on the third visit, and so on throughout the life of the educational order. The same technique can be employed later should the firm undergoing education be utilized for subcontracts.

The chart should be prepared with the responsible executive or executives of the subcontractor's staff and agreed to by them, as it is drawn. It should be attached to a written report detailing the formulation of the plan.

Drawing the Chart

In the preliminary negotiation, plans are formulated ahead for the delivery of specifications, blueprints, tools, and materials, visit of the methods engineer and the follow-up men of the prime contractor, start and duration of the operations, assembly operations, and so on. An angle opening to the right indicates when the particular phase of work is to start; an angle opening to the left, when it is supposed to end. A line connecting the two angles indicates the duration. The subcontractor is familiarized with the use of the chart. As progress is executed for each phase, say half the blueprints are delivered, a heavy line is drawn through half the space.

At designated intervals the chart is brought up to date, preferably by the follow-up man who thus can check and see where obstacles that delay the plan are occurring. The date of examination of the chart is indicated by a V at the top of the chart. The relation of the heavy lines with respect to the V indicate whether or not the plans are behind or ahead of schedule.

In turn the follow-up man can make recommendations, plan them for execution in conjunction with the subcontractor's staff, and on his next visit actually see the progress and effect of revisions.

For example (see Figure 3), the follow-up man, Jenter, in conjunction with Mumford, the methods engineer, found in considering technical modification of the rough gear-cutting operation that the tool would require extra machining and be delayed beyond the period allowed. This latter element is indicated by an *H*, designating a hold-up.

This in turn would delay machining operation No. 1 for two days, and the date is adjusted. Also there would be no need for the prime contractor's operator, Johnson, acting in an advisory capacity, to come in at the time originally planned. Instead his visit is transferred to a period two days later. The symbol *TR*—transfer—is employed.

The procedure is followed until all recommendations are completed, data assembled, and the potential subcontractors standing by for further subcontracts. One of the recommendations should be the development of load charts by the subcontractors so that the prime contractor may be constantly informed as to the potentiality and possible delivery of parts should further subcontracts be let.

* Methods detailed here have been tested in a great many installations by Wallace Clark & Company.

5. Factors Aiding Negotiation of a Prime Contract

Now let us consider the entire sequence from the time a prime contract is solicited until deliveries are made.

The government contract that is not mutually advantageous is more than a failure. It is a distinct hazard because it militates against subsequent relationship. It is of the greatest importance that the contractors and ensuing subcontractors be satisfied with final results, not only in relationships but also in returns. To assure adequate return requires the strictest care in the incorporation of all cost elements in contract estimates.

An organization undertaking a defense contract should proceed with definite data. The contractor must know (1) his own costs and all of his costs, (2) the costs of subcontracting, (3) the available capacity of the plant because of other contracts already on hand, and (4) the available skill and capacity of the subcontractors previously aligned.

Many of the larger contracts, particularly in ordnance material, are negotiated. When both the prime contractor and the purchasing agency have the facts indispensable to complete estimates, negotiation can be successfully concluded and satisfaction by both parties assured. In any case the price should be equitable, and such a price cannot be secured without facts. Once the contract is signed, the purchasing agency should render all aid possible, in much the same manner that the prime contractor aids his subcontractor. And this principle should be recognized, accepted, and planned for.

The principles outlined above may be illustrated by the activities of the French Purchasing Commission in the purchase of about a hundred million dollars' worth of machine tools. The French, although defeated in this war, nevertheless took definite and excellent steps to bolster their industrial facilities, particularly for airplane manufacture. Once on the move they showed the knack of pre-planning their requirements.

Wallace Clark & Company was concerned chiefly with the execution and follow-up of machine tool contracts for the French. Hereafter this organization is designated as the executive agency. The relationship and activity of this executive agency with a machine tool manufacturer of the Middle West, hereinafter called "Paragon," forms the basis for further consideration and evaluation.

Before submitting the contracts to bid and negotiation, a thorough investigation was made of the available machine tool manufacturers. In other words, the agency acquainted itself with more facts, chiefly along two lines: (1) The potentiality of the manufacturer to meet requirements; (2) the financial and organizational set-up.

This latter phase is important. In defense contracting, a personal relationship must be built up for amicable and efficient liaison. And the people with whom you are to deal must be adequate in skill and experience. Machines to produce are not everything. What counts is the brains behind them.

Once the executive agency was assured of the potentiality of the manufacturer to deliver under equitable conditions, it asked him to negotiate. Both parties negotiated with essential facts on hand. The prime contractor knew his capabilities for delivery, had the assurance of potential subcontracting, and knew the costs. The price was set, plans were made for regular visi-

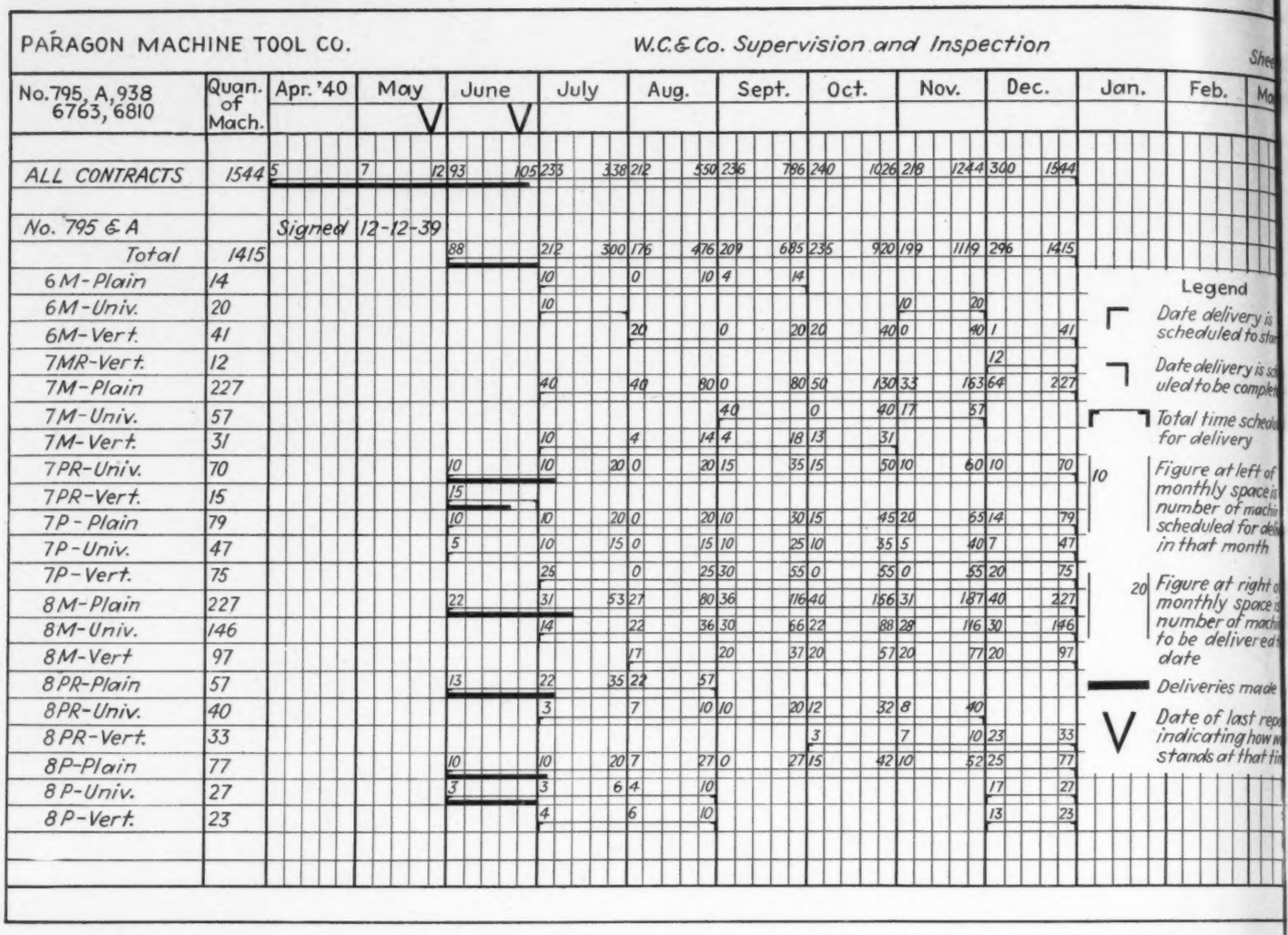


Figure 4. Executive agency's chart shows schedule needed to fulfill terms of prime contract, and progress to date. Heavy lines to right of last V indicate deliveries are ahead of schedule. Those that end to left show delivery dates have not been met

tation by the executive agency's follow-up men and inspectors, and delivery dates were fixed. There was equitability with respect to price, and all aid was rendered, where necessary, regarding advance payments and depositing of funds in escrow for the entire program.

The executive agency charted the terms of the contract respecting deliveries through the use of the progress chart. See Figure 4. The delivery for each class of machine under each contract is indicated. For example, contract No. 795 called for a total of 1,415 machines. A sub-classification of this total is 14-6M Plain machines, of which 10 machines were to be delivered in July and 4 machines in September.

The sum of the classes of machines pertaining to contract No. 795 made up the summary line, and the summary lines for each contract, in turn, governed the summary line for all contracts. Progress could be noted by drawing thick progress lines as machines were inspected and delivered. For example, on the last report coming June 24, as indicated by the last V at the top of the chart, deliveries were approximately three days ahead of schedule for the total of machines contracted for. The details could be analyzed further to see exactly which machines were behind or ahead of schedule. Thus on this and one other chart was represented graphically and simply the situation respecting the deliveries on contracts involving 1,544 machine tools.

The data of progress were secured by the follow-up men of the executive agency. These men were highly skilled in the technical situations involved to effect close personal contact towards the removal of obstacles to deliveries.

An important phase was inspection. Here again was the need for men who were mature in judgment and more than ordinary inspectors. For the relationship established during inspection governed to a great deal the measure of sincere cooperation that was built up. Furthermore, the follow-up men in noting progress secured information as to exact delivery dates, day rather than month. Inspectors could thus be allocated rapidly and effectively in order to get the machines inspected, out of the warehouses, and on to France.

6. Prime Contractor's Relations With Subcontractors

The prime contractor set the delivery dates outlined in the contract and accepted responsibility to plan to these dates. In order to do this he knew, first, optimum amount to be subcontracted, on the basis of subcontracting cost and potentiality of subcontractors; second, additional facilities he must provide.

Subcontracting generally proves, as it did in this case, to be more expensive than production normally undertaken by the prime contractor's facilities. These higher costs are realized from many sources—the need for competent and distinct subcontracting staffs, telephone and traveling expenses, and the technical advice and cooperation that must be furnished, often by taking regular produc-

PARAGON — *Schedule of deliveries – Milling Machines – Contract No. 795* (*Delivery dates advanced as shown*) — *Sheet 1*

Rendle Centerhouse	Quan. of Mach.	Jan. '40	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
TOTAL	1415					16	138 154	205 359	209 561	203 764	253 1017	209 1226	189 1415
Paragon	983						78	145 223	132 355	140 495	183 678	159 837	146 983
Rendle	103					16	10 26	10 36	20 56	14 70	20 90	13	103
Centerhouse	329						50	50 100	50 150	49 199	50 249	50 299	30 329
		Part No. of casting											
6M-Plain-Rendle	14	65661					10		4 14				
6M-Univ.- "	20	65665						10		10 20			
6M-Vert.- "	41	68810				16			4 20		20 40	1	41
7MR-Vert.- "	12	68810										12	
7M-Plain- "													
Total	227	65914					50		30 80	1 81	59 140	36 176	51 227
Paragon	74									1	29 30	23 53	21 74
Centerhouse	153						50		30 80		30 110	13 123	30 153
7M-Universal													
Total	57	65914							11	29 40		17 57	
Paragon	1								1				
Centerhouse	56								10	29 39		17 56	
7M-Vert.-Paragon	31	65383						10		8 18	13 31		
7PR-Univ.- "	70	4605					20			30 50		20 70	
7PR-Vert.- "	15	4255					15						
7P-Plain- "	79	4605					18	2 20		13 33	32 65	0 65	14 79
7P-Univ.- "	47	4605					5	10 15	10 25		13	3 41	6 47
7P-Vert.- "	75	4355					15	10	15	15	5	10	5

Figure 5 (above) shows deliveries by prime contractors and subcontractors. Figure 6 (below) is chart used to detail production schedules

PARAGON — *Progress of Production and Deliveries – Contract No. 795* — *Sheet 1*

	Quan. of Mach.	Jan. '40	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
TOTAL	983						78	145 223	132 355	140 495	183 678	159 837	146 983
		Part No. of casting											
7M-Plain	74									1	29 30	23 53	21 74
Assembly									1	29	23	21	
Machining								1	29	23	21		
Column		65914					1	29	23	21			
7M-Universal	1							1					
Assembly							1						
Machining						1							
Column		65914			1								
7M-Vertical	31							10		8	18 13	31	
Assembly							10		8	13			
Machining						10		8	13				
Column		65383			10		8	13					
7PR-Universal	70						20			30	50	20	70
Assembly						20			30 50		20		
Machining					20			30		20			
Column		4605		20			30		20				
7PR-Vertical	15						15						
Assembly						15							
Machining					15								
Column		4255		15									

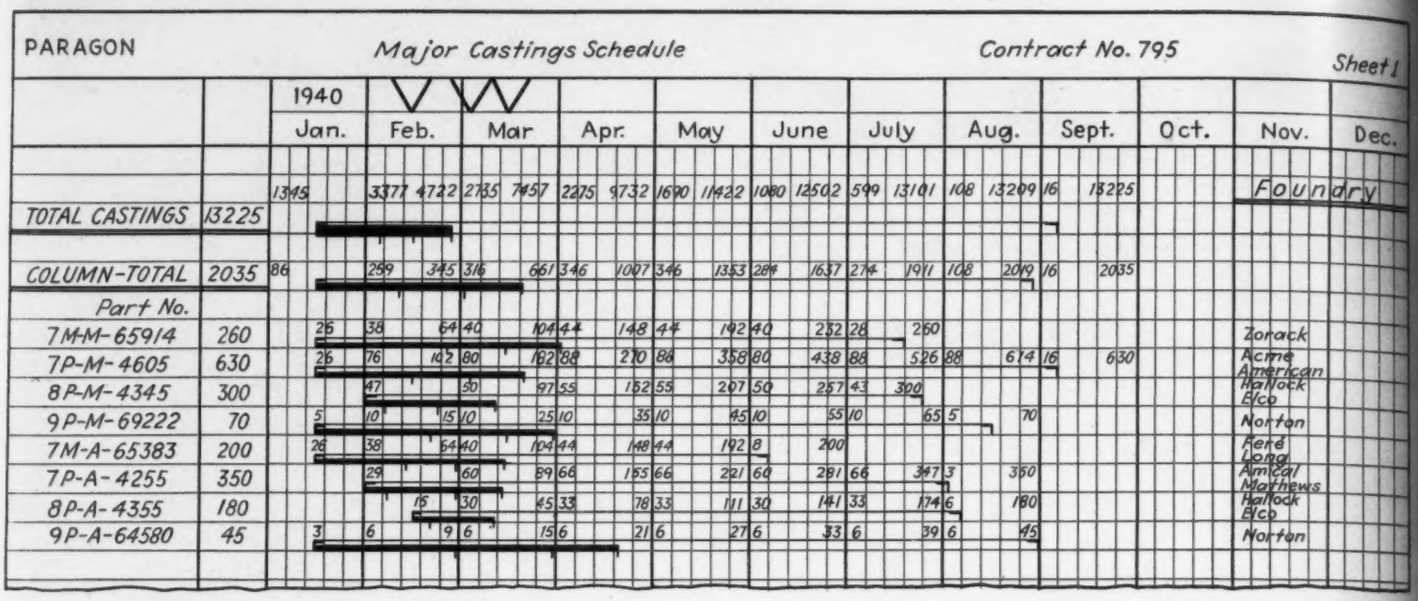


Figure 7. Chart for allocation and delivery of subcontracted parts—in this instance, castings. Names of subcontractors listed at right

tion executives and men from normal duties to aid the subcontractors. The instant that the net profit is wiped out, further use of subcontracting becomes a loss. This point must be determined so that optimum returns may be assured.

In our illustration the prime contractor was able to decide through his pre-negotiatory efforts:

1. What machines he could best manufacture himself.

2. Number of whole machines to subcontract. Paragon had developed excellent subcontracting facilities through the use of two large and prominent manufacturers, designated as Rendle and Centerhouse. These companies were well equipped to make entire machines to the same high quality as the prime contractor.

3. Parts to be allocated to subcontractors—for example, castings.

4. Development of new facilities.

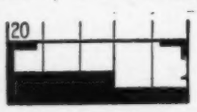
The control of each phase was the same in principle, although variant in details. Here, as previously discussed under educational orders, the close relationships between executive agent and prime contractor, and between prime contractor and subcontractor, were emphasized.

It can be seen from Figure 5 that Paragon on contract No. 795 decided to subcontract 103 machines to Rendle and 329 to Centerhouse, making 983 machines through its own expanded facilities. Delivery dates for each class of machine were advanced to insure a margin of time whereby to meet the contract delivery dates shown on the executive agency's charts. In addition, the organization that was to make the machine was indicated. For example, the 14 machines, type 6-M Plain, were to be made by Rendle in June and August, an advance of one month over the schedule indicated by the executive agency's chart. The delivery dates had been firmly and substantially set during the process of negotiating the contract. Hence the necessity for adequate facts, *particularly as to plant loads.*

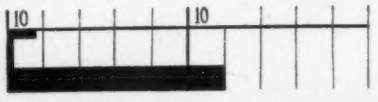
On the basis of this chart showing the allocation, production schedules were detailed for each contractor. Paragon's detail chart, Figure 6, shows the breakdown of operational sequence dates on 983 machines into the receipt of castings, machining operations, assembly, and delivery. Four months were allowed between the receipt of castings and delivery. Thus, roughly, a month's time was allowed as a margin for inspection or prior delays.

Identical charts were drawn for Rendle and Centerhouse. The follow-up men of the prime contractor and the designated members of the subcontractor's staff brought the charts periodically up to date, and the information was transferred from these charts to Paragon's chart (Figure 5) and ultimately to the executive agency's chart (Figure 4).

To show how information was transferred: On Paragon's detail chart (Figure 6) as of June 24 on the 7 PR Universals, it is seen that 20 machines are entirely assembled, and 60 percent (or 12 machines) inspected and delivered. On the chart (Figure 5) this is indicated by:



the line for assembly being narrower than for delivery. The data in turn are located on the agency's charts thus:



as an indication that 12 machines have been inspected by the executive agency and approved for delivery.

The use of these charts illustrates one great advantage: A follow-up man need not expend his energy examining the entire aspects of contract progress; through records maintained by clerical help, he can see where the delivery dates are falling behind, or are threatened by potential obstacles. He can immediately concentrate his attention at the points of difficulty, and call in the appropriate men, whether the subcontractor's or the prime contractor's, or both. All responsible and proper persons get the problem settled before it becomes serious, rather than later when delays have become serious realities.

Subcontracting of Parts

Again the charting procedure was followed with respect to parts. In this example, castings are used. On the basis of delivery dates for machines required for contract No. 795, a master schedule of the necessary castings was drawn up. These castings went both to the prime contractor and subcontractors. It is interesting to note that the schedule was aligned in terms of so many castings a month. The costs here would be more in the nature of the process costs, and the production facilities of the foundries could be aligned for a steady stream of output.

Figure 7 represents the detailed classification and delivery of castings. It is governed by the requirements indicated by the master schedule, and a safety factor is gained by the advance of delivery dates to secure a backlog of castings. But again the schedule is well aligned with respect to a steady and uniform output. To the right are indicated the respective subcontracting foundries which handled the various castings. Again progress was noted in a manner similar to the other charts already described.

Conclusions

Once subcontracting becomes the policy of a company it should be accorded full rights as a pertinent function of the organization, just like sales, purchasing, production, inspection, and financing. Indeed, in many cases it assumes major administrative importance by bringing into play the versatility of the very same organization with all the functions just mentioned. Hard experience has proved that meticulous planning is the only device that will assure results. Avoiding the "perspiration" of the plan brings double trouble.

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FACTORY MANAGEMENT AND MAINTENANCE
McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

MAINTENANCE as the Editors See It

Make Fire-Prevention Week Last 365 Days

INDUSTRY'S ANNUAL RECORD of fires and fire losses is not a matter over which it can be proud and complacent. The record could be worse, of course, but it shows 50-odd millions of dollars in losses and these figures do not take account of injuries or deaths, blasted hopes, loss of jobs, perhaps destruction of the business itself, that so frequently follow in the wake of fire.

There is ample reason for the annual observance of Fire Prevention Week, to be held this year October 5–11. First, it should serve as a reminder that in all plants there is present at every moment of the day and night an unseen menace that can within a few hours transform any one of them, no matter how costly or vitally needed, into a smoking pile of rubbish. It makes no difference in the results whether a fire breaks out from some mishap or neglect, or is started by the arsonist or saboteur.

With this reminder, self-interest will dictate the necessity of making sure that proper and adequate fire-fighting equipment is at hand with personnel trained in its use; that hazards have been reduced as much as possible; that housekeeping is up to high standards.

Only constant vigilance backed by sound knowledge of fire hazards and how to minimize them can give anything like assurance that a plant is reasonably safe from its greatest enemy.

Treat Scrap Metal as A Valuable Resource

AN EXECUTIVE in a small plant recently decided that it would be a good idea to clean house. About 40 truckloads of good scrap metal, worth a nice sum, were recovered. In another comparatively small plant, a similar clean-up brought out scrap metals and materials that added more than $600 to the company's bank balance.

Keeping a plant as free as possible from accumulations of scrap materials of all kinds is good business at any time. Right now it assumes the importance of a prime obligation, in view of the heavy demands for all ordinary metals. It is, or should be, well known that most metals have been put under priority. With a number of metals serious shortages have developed or are impending.

The defense program has been given first call, and rightly so, on all needed metals and materials. Consequently manufacturers of goods that do not have priority rating will have to get along with whatever is left over after defense needs have been met, or find substitutes. Therefore every manufacturer has plenty of incentive, both from the standpoint of the national welfare and his own good, for making available supplies go as far as possible.

To this end there are three steps that every plant can take: First, drag out all scrap metal from its hiding places. Next, collect all turnings and other waste from manufacturing operations. Most important, segregate and classify all waste metal. This action is needed in order to permit reclamation of the nickel, chromium, and other valuable and scarce metals in alloy steels and like materials.

Waste of resources is deplorable at any time. Today it is little short of criminal.

How Good Are Your Signs?

A SIGN IN THE PLANT—especially an accident-prevention sign—isn't worth the powder to blow it to kingdom come unless employees "believe" in it and react instantly to its warning.

To make doubly sure that safety signs do exactly what they are supposed to do, the American Standards Association has announced a new standard which provides for uniform colors and wording, so that even a quick glance will call forth an immediate and automatic reaction. Where danger lurks there may not be time to stop to read and analyze warnings.

Signs cautioning against specific dangers, possible danger, unsafe practices; directional signs pointing to fire escapes, staircases, and exits—are all adaptable.

Trucks are bound to run into dangerous turns in various corners of the plant. Certain doorways may be so located as to be hazardous. In such places prominently displayed signs bearing simple instructions for truck operators are invaluable.

Signs should also be used where operations or processes involve explosive or highly flammable materials; where caution is necessary in the operation and care of presses and other machinery; where quick action is demanded in an emergency.

Then there are the signs whose function it is to save time. Among those are framed and mounted signs indicating location of valves, alarm boxes, fuse panels, switches, telephones.

If you are a car owner, you no doubt appreciate the widespread use of good road signs. On the whole they are well worded, well placed, and prominently displayed. Can you say the same of the signs in your plant?

Buy the Crane That Does the Job

Cranes run into important money. One doesn't buy a new one every day. Careful checking of present and future needs, before final purchase, assures best service at lowest first cost

E. C. RICE, Vice-President in Charge of Crane Division, Whiting Corporation, Harvey, Ill.

OUR NATION'S DEFENSE program, superimposed on rush orders from various foreign powers for war materials, has brought about an urgent need for immediate expansion or major revamping of the production facilities of many industrial plants. And, in the metal-goods industries, a new plant usually necessitates new overhead electric traveling cranes.

Since a new crane represents a large expenditure, and cannot be readily altered to meet changing conditions once it is installed, the crane buyer must give careful consideration to all the many and varied factors involved in crane selection.

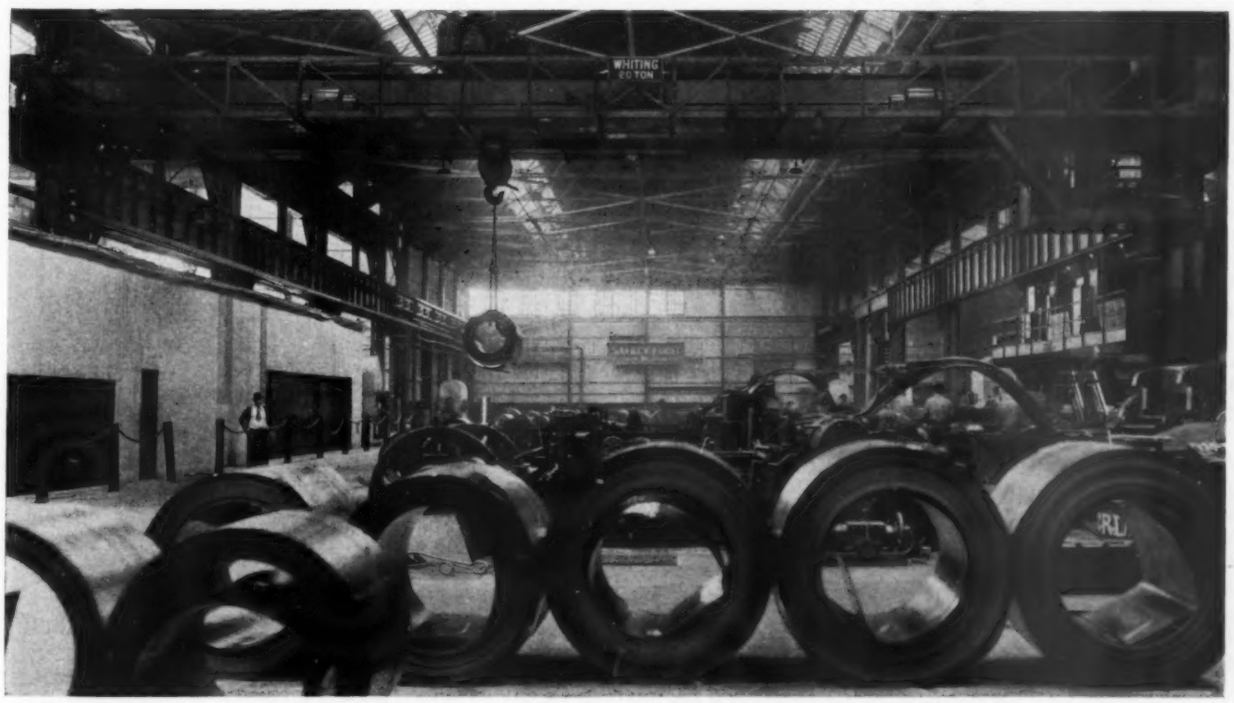
It is the purpose of this article to help the crane buyer analyze his specific requirements so that he will be better able to specify a crane that will fit his individual needs. To this end, requirements in general for each of the various crane service classifications are given, followed by a discussion of important features that should be carefully considered in meeting these requirements.

Service Duty

The class of service has a major bearing on the design of crane that will give best performance at a reasonable cost. Electric traveling crane service is divided, for convenience, into five duty classifications:

Steel Mill—Cranes for steel mills are usually built to the purchaser's specifications, emphasizing safety features, ruggedness, high safety factors, long life of wearing parts, accessibility, oil-tightness, and generally fast speeds. Electrical equipment is usually of the mill type. With a mill in continuous operation, a forced shutdown is costly. Hence, the expense of high standards in crane materials and construction is justified.

Continuous Materials Handling—Cranes used in yards handling a magnet continuously, or a bucket crane handling cement, crushed stone, sand,



Forced shutdowns in steel mills are expensive, so cranes bought for these locations should be chosen with the emphasis on ruggedness, long life of wearing parts, accessibility, fast speeds

or coal, are examples of cranes for continuous materials handling. Such cranes must be rugged, with long-lived wearing parts, and motors selected for the duty cycle involved. Except for certain safety features, specifications for these cranes are similar to those for steel-mill service.

Regular Industrial—This class covers the broad field of cage-operated cranes used in machine shops, foundries, railroad shops, boiler and structural shops, forge shops, lumber yards, stone yards, and conditions of service which, while not continuous, involve enough loads to justify the employment of a regular crane operator. Such a crane is in more or less constant use, handling small loads that cannot be readily placed on a shop truck by hand, holding material that is being set up in machine tools, and often transporting loads 50 percent greater than the crane's rated capacity. Crane specifications for this service generally include a minimum safety factor of five in all parts, with design features insuring economical and safe operation, and 30-min. rated motors with variable-speed controllers. Speeds will depend on the capacity and general duties of the crane. For example, a crane transferring loads from one part of the shop to another will require higher speeds than one used where loads must be carefully handled and accurately placed.

Intermittent Industrial—This service covers cage- or floor-controlled cranes that are not in constant use and have no specific person employed to operate them. Examples of intermittent industrial service are warehouses, assembly floors, side floors in foundries, and freight transfer stations. Because the crane may be called on to lift 25 to 50 percent overloads at times, the specifications should equal those of cranes for regular industrial service; but speeds can be slower, especially if the crane is arranged for floor control.

Standby Service—Where cranes are used to place machinery during erection, and thereafter are used only during the servicing of this machinery, they come under the classification of standby service, the most familiar examples being power plants, substations, pumping stations, and minor freight stations and transfer points. After the erection work is completed, such a crane may be idle for long periods and may never again lift the largest load to be handled, which may be a bed plate to be grouted in place. Because the machinery to be handled is definitely known, together with its weight, the maximum load of the crane also is known, and the specifications can be drawn up accordingly. Such a crane is never overloaded, so a safety factor as great as five is not essential in all parts. Speeds should be slow, and all motions should have variable-speed controllers to assure very slow speed on the first step of the controller, thereby permitting accurate handling of the load during erection and servicing periods. Slow speeds also allow the use of smaller motors, electrical equipment, and mechanical parts, thereby keeping down an investment in equipment that is seldom used.

The first step in buying a crane is to determine which of the five broad classifications outlined above applies to the service conditions encountered. The next step is to determine the proper operating characteristics and features of construction that will give adequate crane performance at the lowest possible cost.

Rated Capacity

The crane should have a rated capacity at least as great as the average load, and not less than 80 percent of the maximum load, it will be called upon to handle, taking into account future plant expansion. Where many of the loads to be lifted are small compared with the maximum load, an auxiliary hoist of higher speed and lower capacity may be desirable, the main hoist being used to do the heavier work. Standard crane ratings are 3, 5, 7½, 10, 15, 20, 25 tons, and up. Too large a crane involves excess weight, which is so much dead load that reduces crane speed and consumes unnecessary power, not to mention its higher first cost.

Speeds

Three different speeds must be considered when selecting a crane—hoist, trolley, and bridge. In general, the speeds of all these motions will vary with the capacity and general duties of the crane. For example, a crane lifting heavy loads should necessarily have slow speeds for all motions, whereas a crane of low capacity can have relatively high speeds. Also a crane that transfers loads from one part of the shop to another will operate at higher speeds than a crane for an erection floor, where loads must be carefully handled and accurately placed.

It is well to remember that the slower the speeds, the smaller will be the electric motors, electrical equipment, and mechanical parts. Slower speeds, therefore, mean lower first cost and less power consumption.

Crane speeds can be grouped into three classes: slow, medium, and fast. Fast speeds are generally associated with steel-mill service and with the continuous service. Cranes for regular industrial service are usually designed for medium speeds, but may employ fast speeds where conditions are suitable. Slow speeds are recommended for intermittent industrial service and for standby service.

Motors

Motor requirements will depend on which one of the service classifications previously descried fits the conditions. For steel-mill or continuous materials handling service, the motor requirements should be determined by a thorough analysis of the duty cycle, which can best be done by the crane manufacturer's own engineers. For regular industrial service, motors should be specified that will run continuously for 30 minutes with a temperature rise not exceeding 55 degrees Centigrade. For intermittent or standby service, motors with a 15-min. rating are sufficient.

Under usual conditions, an open-type motor is the most satisfactory for inside service. For outdoor service and in buildings where the air is laden with dust, moisture, or acid vapors, an inclosed motor should be specified.

The horsepower rating of the hoist motor is directly proportional to the capacity of the crane and to the full-load hoisting speed. For example, a 10-ton crane with a hoisting speed of 30 feet per minute would require a 20-hp. motor. The same crane with a hoisting speed of 45 feet per minute would require a 30-hp. motor, and, likewise, the bridge girders and other mechanical equipment must be made heavier.

The horsepower rating of the bridge-travel motor depends on the maximum speed of the bridge, and it changes with the bridge speed in a ratio that often is greater than a direct proportion. For example, a 10-ton, 40-ft.-span roller-bearing crane will require a 6-hp. motor to give a full-load bridge speed of 200 feet per minute, while a 10-hp. motor will be needed if the speed is increased to 300 feet.

With the speeds met in trolley travel, the increase in motor rating

is usually approximately in direct proportion to any increase in maximum trolley speed.

Where variable speed is required, control may be by an a.c. slip-ring induction motor, with resistors in the rotor circuit, if the power is alternating-current supply. In the case of direct-current supply it is usual to employ a series-wound d.c. motor with resistors in the motor circuit.

With cranes of low capacity, or high-capacity cranes having low hoisting speeds, it may not be necessary to employ steps of speed control, in which case squirrel-cage induction motors of either the single-speed or two-speed type may be used.

An extremely slow maximum speed may require the use of a gear motor, which is available in slip-ring and squirrel-cage types, as well as in the solid-frame d.c. type.

Among a.c. motors, the 900-rpm motor is preferred to the 1,200-rpm motor, since it causes less wear and tear on the brake. Hence, the necessity for brake adjustments and relining is less frequent.

Control

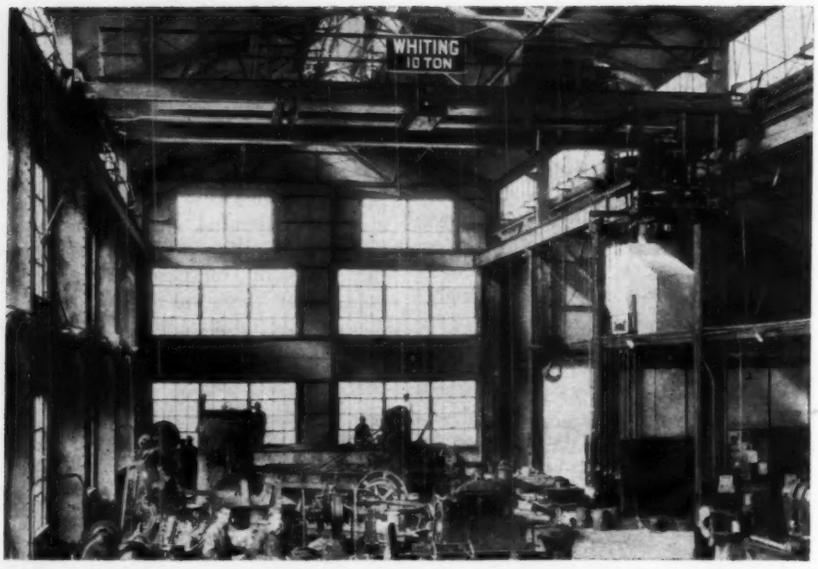
The starting and stopping of the various crane movements, as well as control of the speeds, are generally accomplished from a cage mounted either on the bridge or the trolley. On smaller cranes, however, for intermittent industrial or standby service, where there is no permanent crane operator, the crane may be equipped for floor control by pendant cords.

Control may be either magnetic or manual. Cranes for steel-mill or continuous materials handling service are usually provided with magnetic control or heavy-duty face-plate control, although many heavy-duty cranes are being operated successfully with manual controllers. For regular industrial service, the manual drum or face-plate type of controller is generally used. Where operation is from the floor, as in intermittent industrial or standby service, manual drum or face-plate controllers with spring return are recommended, these controllers returning to the "off" position when the operator releases the pendant cord. The operation of floor-operated cranes may be simplified by the use of magnetic switches with variable-speed pushbutton control.

Gear Drives

Originally, only spur gears were used for gear drives for the three crane movements—hoist, trolley travel,

Loads in the shipping room of a glass manufacturing plant must be accurately positioned and handled with extraordinary care. A 7½-ton crane does this kind of work with the greatest of ease and dispatch



Three-motor, 10-ton crane with 35-ft. span finds many uses in the maintenance shop of a well-known producer of sulphur

and bridge travel—requiring three reductions for each movement. More recently, however, many cranes are being provided with herringbone-gear reductions which, by permitting greater reduction ratios, eliminate one reduction, thereby making a much simpler and lighter construction possible. In herringbone-gear drives, the continuous contact of the teeth reduces friction, noise, and wear, provides greater strength and longer life.

Gear ratios vary with maximum speed the lower the maximum speed, the greater the gear ratio, if the motor speed remains the same. The change in gear ratio affects the tooth pressures and the load on the bearings, and this, in turn, affects the factor of safety. Where these pressures become excessive because of low gear ratios, or the factor of safety drops below the minimum recommended value, it becomes necessary to increase the number of speed reductions.

Hence, in considering maximum speeds for each of the three crane movements, it is important to remember that extremely low speeds, though reducing the power required, may necessitate the use of larger and heavier gear-reduction units to meet the required factor of safety, and at the same time to keep the tooth and bearing pressures within proper limits.

Structural Framework

The type of bridge girder to be used depends on capacity, span, speeds, and service conditions, and can best be determined by the crane manufacturer. Trolley frames and bridge end trucks may be constructed of cast iron, cast steel, or rolled steel. Cast iron is extremely heavy and has a low resistance to impact shock. Steel castings have been employed, but they are heavy and relatively expensive. Rolled steel, either welded or riveted provides a strong, lightweight construction that is able to resist impact.

Cage

The cage may be mounted either on the bridge or trolley. If mounted on the bridge, it should be located next to the runway wires to avoid the extra cost of running conduit wiring across the bridge to the cage.

If the crane is to be used for outdoor service, the cage should be inclosed for the operator's comfort. For indoor service, although it is customary to have an open cage, inclosed cages are desirable in unheated buildings.

Bearings

Crane bearings may be of either antifriction or sleeve type. Sleeve bearings, as ordinarily constructed, are less expensive than roller bearings. However, sleeve bearings have certain inherent disadvantages. Because the weight of the shaft squeezes out the lubricant while the crane is at rest, sleeve bearings have high starting friction. Motors for such cranes must have a higher starting torque and more power must be expended in starting. Also, sleeve bearings require frequent lubrication and attention.

On the other hand, good antifriction bearings have low starting and running friction. They reduce the size of the motors required, provide smooth operation at all times, and require lubrication only at infrequent intervals.

Lubrication

Adequate means of lubricating all wearing parts is one of the most vital features of a crane. All gear units should operate in an oil bath, completely inclosed in oil-tight, dust-proof cases. Bearings on the speed reducers should preferably have splash oil lubrication. All other bearings should be lubricated by high-pressure grease guns, thereby insuring that any dirt or grit that may have entered the bearing will be expelled with each application of new grease.

The following features should be incorporated in all electric overhead cranes:

All gearing inclosed.

No overhanging gears or pinions.

Rail sweeps on all bridge and trolley wheels.

Steel walk with safety treads full length of bridge on drive side.

Guards over drive-shaft couplings.

Ladder from cage floor to footwalk.

Hoist provided with device that will give automatic control of the load while lowering, and also with brake to provide positive suspension of the load in any position when electric power is cut off.

Foot brake on bridge drive controlled from the cage.

Limit switch, with automatic reset, to prevent over-travel of the hook.

Main switch and fuses inclosed in steel safety cabinet interlocked so that main switch must be "out" before the cabinet can be opened.

All wiring properly insulated and run in iron conduit or raceway. Wiring done in accordance with the National Electrical Code. In states or cities having special safety or electrical codes, these should be mentioned in the specifications.

A gong mounted in cage operated by foot lever.

Outside cranes equipped with latch for locking crane to the runway when not in use.

Cage provided with ample room and arranged to give operator clear vision of the hook.

Before You Reapply Motors

First make sure that the characteristics of both motor and load are a close match. A motor that is misapplied can't operate efficiently, may soon fail

W. R. HARRIS, Industrial Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh

A SPECIAL MACHINE required driving motors that had to start and reverse several times a minute. Spare 5-hp., general-purpose squirrel-cage motors were applied that had a starting torque of 150 percent and a starting current of over 600 percent. The motors overheated and eventually burned out. An analysis of the load indicated that 3-hp. high-slip motors with a starting torque of 300 percent and a starting current of 400 percent would be adequate. These motors, although smaller in horsepower, develop 20 percent more starting torque with only 40 percent of the starting current of the motors used at first.

Identify Its Characteristics

The high-slip motors are running cool and consume considerably less power on starting and plugging.

One of the first problems, then, in reapplying a spare motor is the identification of its characteristics. This matter is relatively simple with d.c. motors, since a glance at the nameplate and an examination of the field structure are usually sufficient to tell whether it is shunt, compound, or series wound or whether it has special characteristics. In general, therefore, d.c. motors can be reapplied with complete confidence.

With a.c. motors the problem is different. There are many different types, particularly of squirrel-cage motors, and it is almost impossible to determine the characteristics from external appearance. (See Table I.)

The same is true of synchronous motors. (See Table II.) Designs for different applications may have widely different values of starting, pull-in, and pull-out torques that may or may not be suitable for the job on hand. An examination of the nameplate will in most instances provide the information needed, although it may be necessary to consult the manufacturer for further details.

Here are some general facts that may be helpful in reapplying motors to machines that have similar load conditions:

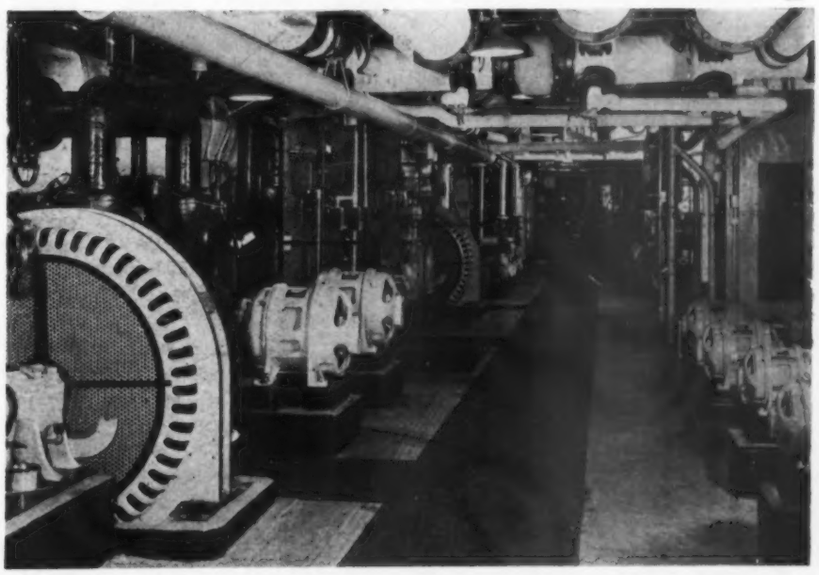
Many industrial drives, such as those for materials handling equipment, table rolls, centrifuges, and special machine tools must be started, reversed, or plugged frequently under load. Loads of this general type require high-slip, high-starting-torque motors that have a high ratio of starting torque per ampere and consequently can be accelerated or plugged with a minimum of loss and heating.

Short-time-rated, high-slip motors for cyclic duty on hoists, elevators, tire molds, and various roll lifting and moving mechanisms take care of their intended jobs nicely and are low in first cost. These motors are of smaller frame size than continuously rated, general-purpose types of the same horsepower and are worked very hard in order to obtain their short-time ratings. Consequently they are not suitable for driving continuously running machines, even if the actual power required is only a fraction of the short-time rating.

Recently a spare 7½-hp. short-time-rated, high-slip motor was applied to a pump that requires only 5 horsepower. The motor overheated and burned out. The winding was thought to have been faulty; therefore the motor was promptly rewound and put back into service—and just as promptly burned out again. The pump was a vital machine and its outage created a serious situation. A brief check-up showed the cause of the trouble, and a 5-hp. general-purpose, continuously rated motor was applied satisfactorily.

If no restriction is imposed on starting or momentary peak currents, plant operators usually are free to make any type of installation desired. Occasionally, where supply lines are long and voltage is low, trouble may be experienced. Here is a typical instance:

A lineshaft in a mill required 100



Synchronous motors drive these refrigeration compressors; squirrel-cage motors drive the circulating pumps—each type used where it is best suited

horsepower and needed approximately 125 percent starting torque. A spare general-purpose motor that develops 150 percent starting torque at 600 percent current was applied. Immediately motor starters began dropping out. The difficulty was finally found to be the momentary voltage drop caused by the low-power-factor, high-starting current of the 100-hp. motor flowing through the long, reactive power line.

Drop-Outs Disappeared

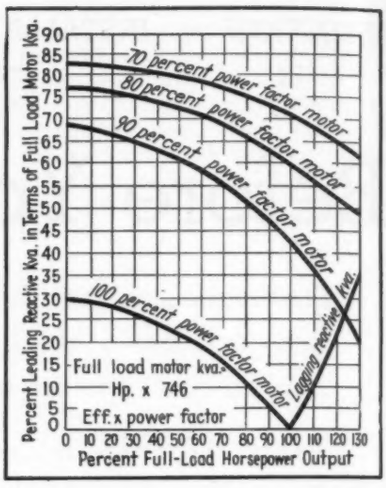
Then a high-starting-torque, low-starting-current, normal-slip motor with a starting torque of 250 percent and a starting current of 500 percent was applied, with a transformer-type autostarter. On the 80 percent tap this motor developed approximately the same starting torque as the original motor, although the current taken from the line was only 55 percent of the former value and at higher power factor. Needless to say, the starter drop-outs disappeared.

Punchpresses are used so widely that an induction motor bearing that name is listed as standard by most manufacturers. The punchpress motor is of the high-slip type for use with a flywheel on intermittent, high-peak loads. High-slip is necessary to permit the flywheel to give up its stored energy to help carry the machine through a peak load. There are, however, some classes of punchpresses in which the strokes occur with unusually high frequency, for which this characteristic is not suitable.

For example, a spare 5-hp. high-slip motor was reapplied to a punchpress equipped with a flywheel. The number of strokes per minute was so high that the flywheel had practically no effect. The motor never reached full-load speed—a condition which resulted in overheating and eventual burnout.

After careful consideration the flywheel was removed, and a 7½-hp. normal-slip motor was installed. This motor has ample pull-out torque to drive the press through a stroke without the aid of the flywheel, ample thermal capacity for the duty cycle, and operates at high efficiency.

When a squirrel-cage induction motor is required to bring a heavy flywheel or other high-inertia load up to speed, the loss in the rotor is the same as the energy stored in the rotating mass. The motor must have enough thermal capacity to store this energy; otherwise it will overheat and burn out during the accelerating period. Low-speed, direct-connected motors are inherently better in this respect than high-speed motors because of the greater volume of material available to absorb the loss.


Percent Leading Reactive kva. in Terms of Full Load Motor kva.
70 percent power factor motor
80 percent power factor motor
90 percent power factor motor
100 percent power factor motor
Leading reactive kva.
Full load motor kva. = Hp. x 746 / Eff. x power factor
Percent Full-Load Horsepower Output

Reactive kilovolt-amperes delivered by synchronous motors vary with changes in mechanical load

A spare 1,750-r.p.m., general-purpose, squirrel-cage motor was belted to a 60-in. wood hog weighing approximately 3 tons and running at 600 revolutions per minute. Such a mass rotating at this speed represents approximately 2,100 horsepower-seconds of stored energy. An equal amount of energy appears as heat in the rotor of the motor during the accelerating period.

The motor burned out during the first starting period, and there was an

TABLE I. Characteristics and Applications of Squirrel-Cage Motors

Class of Motor	*Time*	*Starting Torque, Percent of Full Load*	*Pull-Out Torque, Percent of Full Load*	*Starting Current Percent of Full Load*	*Approximate Percent Full-Load Slip*	*Typical Applications*
NEMA Class A: general purpose, normal starting torque and current	Continuous	Up to 150	200	600–700	2–3	General industrial loads—pumps, fans, compressors with unloaders, blowers, machine tools
NEMA Class B: low starting current, normal starting torque	Continuous	Up to 150	200	500–600	2–3	Same as NEMA Class A
NEMA Class C: high starting torque, low starting current, normal slip	Continuous	200–250	175	500–600	2–3	Loads requiring high starting duty—heavy conveyors, plunger pumps, or compressors. Also used with transformer-type starter for medium-starting-torque service with low starting current
High slip	Continuous or Intermittent	250–300	.....	400–500	7–13	For high-peak loads where flywheel is used — punch-presses, oil well pumping, materials handling or table rolls, special machine tools. Special designs may be required
Torque Motors	Intermittent Rated by torque only					For loads requiring high torque intermittently — valves, door openers, tire and tube molds, roll lifting and moving mechanisms

annoying delay until a motor of lower speed and better starting characteristics could be obtained.

Starting torques required of synchronous motors for compressor service, centrifugal pumps and blowers, jordans in paper mills, and similar types of equipment are low—usually 50 percent or less of full-load value. When reapplying such motors it is necessary that the starting conditions fall within the motor capabilities.

For instance, a spare synchronous motor originally specified for compressor service was reapplied to a group drive in a flour mill requiring approximately 150 percent starting torque. The motor failed to start the load, and a costly delay occurred until it could be replaced.

The pull-in torque of a synchronous motor is defined as the maximum constant torque under which the motor will pull its connected inertia load into synchronism, at rated voltage and frequency, when field excitation is applied. Loads such as bandsaws, wood hogs, and shippers have extremely heavy rotating parts, and synchronous motors for driving these machines must be designed to pull the heavy masses successfully into synchronism. Before synchronous motors are reapplied to loads of these general types, a careful check should be made of the pull-in characteristics.

Too Much Pulley

An interesting example of difficulty with "pull-in" occurred when an old steam engine driving a large, low-speed, ventilating fan was replaced by a spare synchronous motor. With the engine drive a very large and heavy pulley was used on the fan shaft. It was not convenient to remove this pulley; so the motor was connected to the fan with the pulley in place. The motor failed to "pull-in," because of the added inertia of the pulley, and it was necessary to remove the pulley before successful operation was obtained.

Magnetizing current required by inductive apparatus such as transformers, induction motors, and some electric furnaces is an unseen item in every power bill. Although magnetizing current is essential to the operation of such apparatus, it does no useful work. An indirect payment for this idle power or wattless current is made either in the form of kilovolt-ampere demand rates or a power factor penalty, whereas high power factor is sometimes recognized in the form of a power factor bonus. The 80-percent leading power factor synchronous motor will neutralize part of the magnetizing current and thus raise power factor.

When using spare induction motors to replace synchronous types the effect on the over-all plant power factor should be considered. The following example illustrates what sometimes happens:

A 50-hp., 80 percent power factor (leading) synchronous motor driving a compressor in a small plant failed and was replaced by a spare 60-hp., low-speed squirrel-cage motor that operated at approximately 80 percent lagging power factor. It was soon noticed that the monthly power bill was considerably higher than usual.

Investigation disclosed that before the change the average plant power factor was around 90 percent, whereas now it was around 72 percent, resulting in approximately 25 percent higher kilovolt-ampere demand with the same kilowatt load and higher power bills. By replacing the 80 percent leading power factor synchronous motor with the induction motor, 30 leading reactive kilovolt-amperes were replaced by 30 lagging reactive kilovolt-amperes, which in effect added 60 lagging reactive kilovolt-amperes.

Synchronous motors operated at partial loads with rated excitation deliver more leading reactive kilovolt-amperes than at full load. This increase is, however, not so great as is widely supposed. Take the case of a compressor that requires a 200-hp. motor. Spare 200-hp., 80 percent power factor and 300-hp., 100 percent power factor motors are available. Since the maximum corrective effect possible is desired, which motor should be applied?

It may seem surprising that the 300-hp., 100 percent power factor motor at two-thirds load and rated excitation will supply only 36 reactive kilovolt-amperes or 15 percent of the 240 full-load kilovolt-amperes. See the accompanying curves. On the other hand the 200-hp., 80 percent power factor motor will supply 120 reactive kilovolt-amperes—more than three times as much.

A 600-hp., 100 percent power factor motor operated at a load of 200 horsepower would be necessary to furnish the same corrective effect as the 200-hp., 80 percent power factor motor.

Aside from electrical characteristics, proper attention should be given to mechanical features, such as the method of mounting, protective covers, and inclosures. Some materials, such as rock or cement dust, sawdust, and cotton lint, are not injurious to the motor windings, but unless they are blown out frequently they will restrict ventilation and may cause excessively high temperatures. Other materials, such as metal dust from grinders and machine tools, chemicals, and water, are injurious; maintenance can be reduced by excluding them from the motors. It is a mistake to apply unprotected motors where protection is needed, because the additional maintenance and greater possibility of trouble will soon wipe out any initial saving.

Therefore, before reapplying motors, the nature of the application along with local conditions should be carefully considered. Usually the small amount of study required will pay big dividends in better, more efficient performance, trouble-free operation, and low maintenance costs.

TABLE II. Characteristics and Applications of Synchronous Motors

WR^2	*Starting Torque*	*Pull-In Torque*	*Full-Speed Running Torque**	*Typical Applications*
High	Low	Depends	Low	Wood chippers, wood hogs, bandsaws
High	Low	High	High	Centrifugal loads, large ventilating fans mine fans
High	High	High	High	Lineshaft drives, flour mills, paper mills
Low	High	High	High	Rubber mills, paper beaters, cement, tube, or ball mills
Low	Low	Low	Low	Unloaded machines, compressors, jordans, motor-generator sets
Low	Low	High	High	High or medium-speed centrifugal pumps or fans

* This value is a measure of the torque before synchronization — not the operating load

Our Test Instruments Work 24 Hours a Day

There are always a lot of empty spaces on the shelves where Gardner-Denver stores electrical testing instruments. Each gap means a tester is out in the shop somewhere earning its keep

A. G. FESLER, Plant Engineer, Gardner-Denver Company, Quincy, Ill.

SOMETIMES WE WONDER whether we are lacking in ingenuity, or whether the correct interpretation is that we take electrical instruments so completely for granted that we do not think up unusual uses for them.

To us, electrical instruments are workhorses. We use them every day, for all manner of ordinary purposes. We have what visitors tell us is a large list of instruments, ranging from insulation resistance meters and clip-on ammeters to power analyzer, recording wattmeter, and some special instruments that we have made up for our own use out of standard parts, because we did not know where to get the completed units.

We use this rather elaborate instrumentation almost exclusively in routine testing. When one of our electricians goes out to make a routine check—whether of a circuit, a motor, or the condition of a production machine—he takes with him whichever of the instruments is needed for his task. Several shelves in the electrical shop are devoted to storing our inventory of electrical instruments. At any time of day or night, and still more noticeably on Sundays and holidays, you can see empty spaces on these shelves. Each gap represents an instrument that is out somewhere in the plant, performing the service for which we purchased it, or some service closely allied. Thereby it earns its keep, and returns a net profit that makes our investment in instrumentation yield as liberally as anything in the electrical department.

We have always been somewhat proud of one bit of detective work that we achieved with the aid of a recording wattmeter. We had word from one of the major production departments that it was running low on compressed air supply, and would accordingly be needing another air compressor. That looked odd to some of us, because we knew the general needs of that department for compressed air, and it seemed as though the existing equipment should be able to keep up with the demand.

So we used the recording wattmeter to ascertain what proportion of the machine's capacity was being used for leaks. We took some runs that included noons and weekends, when no air was being usefully employed, and found that even at such times the compressor motor ran at an average a little above 25 percent of load. This showed rather clearly that if the department's additional needs for air would not be more than 33 percent above what they had been, this capacity could be supplied by the simple expedient of plugging up the air leaks in the lines.

We use our recording wattmeter for a wide variety of tasks. Whenever we have the problem of determining what motor will fit a given operation, or of determining to what extent the power requirement has been changed by a shift in machine use or location, we give it a whirl with the wattmeter for hours or days, and act accordingly. Whenever a sustained knowledge of load characteristics is the goal, the recording wattmeter is put to work.

We often use this instrument, and others, to check on a machine that is

Gardner-Denver Instruments and Their Uses

1. Megohm insulation meter. Routine checks. Every motor is checked regularly, at least once every three months, and motors on heavy machines every week.
2. Ohmmeter. Used for balancing up phases on motors that we suspect of being shorted or that keep blowing fuses; also to balance phases on newly rewound motors.
3. Tong-type ammeter. Circuit checks, and routine checks on motor performance. Has double-scale ranges 0–100, and 0–500.
4. D.C. ammeter. Load testing inspection on all our equipment, for a load check on d.c. motors on machine tools, and so on. Also used on certified efficiency tests on our own products sold to the government requiring such certification.
5. D.C. ammeter, 0–300. Circuit load tests.
6. Power factor meter. Motor performance tests and circuit analysis tests.
7. A.C. voltmeter. All voltage checks on circuits.
8. A.C. ammeter, 0–100. Used for load checks on motors.
9. A.C. voltmeter, 0–500. Power circuit checks.
10. D.C. voltmeter, 0–300. All D.C. apparatus testing.
11. K.W. meter. Load characteristics tests.
12. Industrial analyzer. All circuit analysis and on individual motor checks.
13. Recording wattmeter. Load characteristic tests on which a record is desired. Usually where a 24-hour test is needed.
14. A.C. ammeter, 0-30. Used for small motors.
15. Overload relay element tester.

not functioning as it should. Apply the right instruments to the problem and they will soon yield the answers to whether the trouble is mechanical, electrical, a tight bearing, or whatnot. Frequently, when the time-study department has a lingering doubt as to some element entering one of its calculations it calls upon us for aid.

In our plant we have two major power supplies, one of 25 cycles and the other of 60 cycles. Power factor on our 25-cycle supply is around 0.86, and on our 60-cycle around 0.93. The reason for these relatively good showings in a metal-working plant is, of course, that the conditions in the departments are right to produce a high power factor. But—the reason why conditions are right is that the electrical instruments give us the information on which to plan them right.

For instance, we know that machine tools are motored for the maximum capacity of the machine, which is more than is necessary to carry the normal loads. The sad part, from the standpoint of power factor, is that we cannot remotor these machines.

Penalized for Low Power Factor

We know that our power factor in the shop is undoubtedly down, on some feeders in production departments where lots of inducation motors are being used. We pay little attention to the power factor on individual circuits, because our concern is principally with the main circuit—we are penalized when power factor falls below 0.8 lag, average for the month as shown on a reactive meter. On the individual shop circuit we merely watch for excessive voltage drop rather than low power factor, and, when it appears, we hang in capacitors large enough to correct the condition. We make a routine check of line voltage every six months or so. But, before a machine is set or moved, we test the line to see whether we have enough copper.

We regulate our power factor largely by taking frequent readings on the main circuits, to see how we are running in relation to the penalty minimum. On our 25-cycle lines, we have four synchronous motors: a 60-hp. on a motor-generator set, with 0.6 leading p.f.; a 150-hp., also on an m.g. set, with unity p.f.; a 200-hp. on testing pumps, with 0.8 leading; and, a 150-hp. on a shop air compressor, with 0.8 leading. At times, when we think it advantageous to raise our p.f. average over the month, we merely float the 200-hp. motor on the line, and keep well within our limit. On the 60-cycle lines, we keep checking p.f., and whenever it shows a dangerous drop, we hang a few more capacitors wherever they will do the most good to individual circuits.

An electrician goes out to make a routine test. Jack Fesler (right) hands out instructions and an instrument at the same time

One interesting instrument, which we made for ourselves because we did not know where to buy just what we wanted, has a stepdown transformer inside that steps down the voltage and gives us a rather high amperage output that can be carefully regulated from 1 to 50 amperes. By applying this amperage across an overload relay element, we can simulate actual operating amperage conditions, both for normal and abnormal currents. We read on the meter the amperage required to make the element operate in the time specified by the manufacturer, and thus test to make sure that no element goes into an overload control that will fail to shut off the motor in time to save a burnout.

We test every relay control element before it is installed in the plant. Also, once a year, we test with this instrument every such element already installed. This 100 percent inspection of relay elements has greatly reduced our loss from overloading motors.

Our analyzer is used in trying out new machine tools, new cutting tools, new materials, new methods—whenever we learn that changes of this sort are coming along. When we check a situation, we want all the data that a power analyzer supplies. This is one of our best means of checking changing conditions. Also, our product engineers use the analyzer and many of our other instruments in testing machines made by our plant for sale to customers. Usually the electrical department installs the instruments for the tests, and the production department's electrical engineers interpret the figures thus obtained.

New Circuits, Better Welds

Installation of new buses and cables designed for low reactance greatly improved regulation of welder distribution system, made it possible to weld heavy parts on a production basis

T. O. MORGAN, Electrical Engineer, Buick Motor Division, General Motors Corporation, Detroit

OUR FIRST WELDERS were connected to a power distribution system feeding machine departments. The bumpy welding load, however, caused poor voltage regulation and also led to unsatisfactory welding conditions as more and more welders were added.

Power needs and welding needs differ widely. A 100-kva. motor will impose a 100-kva. load continuously, whereas a welder of the same rating will make a demand of from 500 to 1,000 kilovolt-amperes for a period of one second per weld. In other words, power equipment imposes a high-energy, low-demand load, whereas welders impose a high-demand, low-energy load, although the heat dissipated in each instance, including the duty cycle of the welder, is the same.

The first step, obviously, was to separate current distribution to welders from that to machine tools. Current for welders was distributed by a multi-cable system. But we found that the voltage regulation was still poor; as more and more welders were added, the distribution system began to heat up. After the segregation and the installation of regular welding transformers, it was possible to connect to them welders totaling twelve times the rated capacity of the transformers.

In the old system, resistance of the wiring and inductance cut the current flow so that when welding sheet metal 30 percent regulation in the distribution system was common. The practical limits of voltage drop indicated by past experience were determined to be 20 volts for welder and control, 20 volts for the distribution system, and 35 volts for transformers. This total represented 15 percent of the system voltage. It is possible to weld iron with a maximum drop of 15 percent, but with alloy steel it is another story.

Attempts to weld with voltage regulation greater than 15 percent were unsatisfactory. The engineering department would not okay the welds because they were not uniform.

Welder current regulation may be improved more economically by adding transformers to the system, especially if the feeders from substations are short. If long feeders of the old type are already installed, however, it is more economical to invest in a new type of feeder. As a matter of fact we did both. We were after proper current regulation, but with a minimum of cost for feeders, transformers, and buses.

Preparations for our 1941 model made us search for a good, efficient distribution system flexible enough to adopt for standard practice. A rigid concentric cable was available, consisting of an outer and inner copper tube separated by a layer of insulating material, which would serve between the transformer and welder breakers. Heat dissipation characteristics were not entirely satisfactory, however, and a different design was desired—one that would have low resistance to current flow and at the same time provide for maximum heat dissipation.

Fulfills All Requirements

A design was eventually developed commercially that fulfills both requirements. It consists of two copper busbars isolated by a strip of insulation and housed in a metal cover similar to the ordinary bus duct used for machine power distribution. Provision is made for cutting in welder breaker taps at regular intervals along this bus, but care has to be exercised not to rupture the insulation strip between the two copper bars.

This type of bus solved a part of the problem of current regulation. The drop per 100 feet per 100 amperes was approximately 2 volts with the old open cable system; for the new bus the corresponding drop is 0.166 volts.

With this great improvement in current regulation, we still had the problem of getting power from the breaker to the welder. If ordinary cable were used, the high a.c. resistance would absorb much of the advantage of the new power duct from transformer to breaker.

A two-conductor, concentric flexible cable was chosen as the feeder to give the best regulation and provide flexibility in the shifting of the welding machines at minimum cost and

Mr. Morgan came to Buick following his graduation in electrical engineering from Michigan State College in 1928. After a year of experience in high-voltage electrical construction and maintenance work he was appointed electrical engineer. All electrical construction and revision by the works engineer department come under his jurisdiction. Away from the office he relaxes by hunting with bow and arrow, and fishing for trout.

with minimum loss of time. Heat dissipation was not the factor here that it was in the design of the main duct because the heat rise from only one welder is involved, whereas the heat rise from all welders was involved in the problem of designing the main duct.

With the dimension tolerances for fittings, current, and duty cycle specified, cable companies were in a position to figure on the temperature rise and hence recommend the type of insulation to be used. The result was the development of a flexible, concentric cable for use between switch centers and machines. It consists of a center core of stranded cable surrounded by a layer of insulation that in turn is covered by a single layer of stranded cable with an outer covering of insulation.

The net result of our efforts to get better voltage regulation, and hence uniform welds in heavy steel parts, is a 5 percent regulation on the entire system.

Twenty Welders Needed

For these heavy welding operations 20 welders ranging from 200- to 600-kva. rating are required. It is unlikely, of course, that these machines will all operate at the same time, but any one may have a peak of 4,500 amperes, and from this value it will range down, as a general rule, to 5 amperes per kilovolt-ampere of rating for the smaller machines.

The number of welders on one circuit is important, because the greater the number the more nearly the power curve approaches a continuous load. It is easier, for example, to distribute power to 300 welders requiring 20 kilovolt-amperes each than to 20 welders requiring 300 kilovolt-amperes each, because there is less probability that the first group will all impose their peak loads together.

Primary feeders to the several welding centers in the plant all originate from one panel in the powerhouse. Energy at 5,000 volts is fed from the powerhouse to transformer banks in the building where this heavy-duty welding is done, and then to a main secondary breaker. Two runs of the welding duct mentioned above extend from this main welding breaker through the shop, one-half the welding load being carried by each run. Three or more welders are usually grouped and served by a common concentric cable run from the duct to an air circuit breaker, and thence to the group of welders.

With this arrangement the power factor may range from 20 to 50 percent. It varies with the physical arrangement of the secondary of the welding transformer.

Two machines, with a slide between them, are needed to weld pads to rear axle housings. Breakers and controllers are mounted on the platform overhead

Special low-impedance, (1.67 percent) oil-cooled transformers are used for the power supply. We begin with a 200-kva. transformer and add in steps of 300 kilovolt-amperes, as warranted by the increasing load and a known stress factor. Normal banks have about three transformers for each distribution center.

Our experience in going to the welding of heavy steel structures on a quantity production basis, where uniformity of welds is a rigid requirement, shows therefore that the distribution layout must have certain design features.

A welding layout, including branch feeders, main feeders, stepdown transformers, and the primary feeder from the powerhouse, should be designed primarily from the standpoint of voltage regulation. It seldom happens that a welding distribution system so designed will be likely to develop heating problems.

Some conditions of location such as inadequate utility feeder lines, may of course, prevent the attainment of a desirable minimum regulation in the manner described. In such instances, inertia generators would have to be used on the line to supply instantaneous demands and produce the regulation desired.

Budgeting a Year's Maintenance

Third installment—explains how comparisons are made between standard and actual maintenance costs for each department

EARLE CAZAYOUX and D. J. McNUTT, Libby-Owens-Ford Glass Company, Toledo

WE HAVE, in the two installments published in June and July, shown how budget figures are set, and traced maintenance labor and material to the individual departments in which they are used; it remains to explain how they are combined and compared with the budget standard.

The payroll department enters the labor on a "repair and maintenance report of actual cost." This is divided into departmental account numbers for both material and labor, according to the class of maintenance labor. Payroll enters only the labor, of course. This form then goes to the stores ledger clerks, who enter the material charges that they have previously summarized by departmental account numbers, as described in July. We are now ready for budget comparisons of actual maintenance expense with the standard.

The control department takes this monthly repair and maintenance report of actual cost, and enters the material and labor there indicated by departmental account numbers on the budget sheet. This sheet is called "the distribution of repairs and maintenance labor, material, and overhead to departments." One of these budget sheets is made out for each of the company's plants.

An examination of the form below will show that each productive department is charged with the actual labor and material expended in it during the month. This is compared with the budget standard, the derivation of which was explained in the June installment of this article.

We still have, however, to describe the overhead part of the budget sheet. This has to do with the overhead in the maintenance department—indirect labor, supplies, and material used in keeping the maintenance department in operating condition. The accumulation of these various charges follows the same procedure outlined for a productive department.

To Determine Overhead

The total in dollar value of all charges to the maintenance department is divided by the total dollars of actual maintenance labor used during the month, to obtain a percentage figure. This percentage is then applied to the maintenance labor figure

Each production department is charged with actual labor and material used during the month. These expenses are compared with the budget standard. One of these budget sheets is made out for each of the company's plants

#6 - ROSSFORD - DISTRIBUTION OF REPAIRS AND MAINTENANCE LABOR, MATERIAL, AND OVERHEAD TO DEPARTMENTS MONTH.....

ACCOUNT NO.		ALLOWANCE BASIS	STANDARD RATES LABOR	STANDARD RATES MATERIAL	ACTUAL UNITS	LABOR STANDARD	LABOR ACTUAL
6-186	Power & Boiler	Per Million Lbs. of Steam Produced	$ 6.04	$ 6.75			
	Extra Allowance						
	Total 6-186						
6-386	Box Shop	Flat Per Month	9.00	8.00			
	Extra Allowance						
	Total 6-386						
6-586	Mixing	Per Ton of Batch Mixed	.085	.040			
	Extra Allowance						
	Total 6-586						
6-986	Furnace Hall	Per Furnace Cast	7.68	3.50			
		Per Furnace Hour Down		.50			
	Extra Allowance						
	Total 6-986						
6-1086	Casting Hall	Per Furnace Cast	7.68	2.00			

stated for each operating department on the budget sheet, to secure the actual maintenance overhead. The standard with which this actual figure is compared, is obtained by relating past overhead maintenance expenses to a thousand man-hours of maintenance labor—the three-year running average.

Before relating what action is taken on the basis of monthly comparisons of actual expenses with budget allowances, the "extra allowances" mentioned under each department on the budget sheet must be explained.

Allowances Are Extra

Extra allowances are not a part of the budget, because they cannot be foreseen a year in advance, which is the maintenance budget period. If an expense can be foreseen, it becomes a part of the budget. The money value of a repair job is not, consequently, the dividing line between what is a budgeted item and what is an extra allowance. For example, the engineering department moved out of the office building at one of our plants. The space had to be rearranged, and partitions changed, for the remaining departments. A budget for maintenance of the office was in operation, but this revision was considered as a non-recurring item that had not been anticipated, and therefore an extra allowance was made. These special items must be approved by the central office; work orders are issued for them, and the maintenance labor and material used are charged and accumulated in the manner described for a work order. The actual cost charged to a work order is, of course, compared with the estimated cost.

Perhaps it is just as well to mention at this point that we have some 50 to 60 recurring maintenance jobs. These cover, for example, maintenance department men assigned permanently to an operating department; and the monthly check-up and repair of all time clocks to avoid issuing separate orders, and, incidentally, to avoid the disrupting results of clock breakdowns. The maintenance clerk issues these standing orders monthly, and sends a copy to the foremen of the appropriate class of maintenance labor. The checking and charging of labor and material to these orders follows the same procedure as outlined for the ordinary non-recurring jobs which we have discussed.

Now for a consideration of the con-

LIBBEY-OWENS-FORD GLASS COMPANY

PLANT No. 6 - Rossford

DEPT. #6-1500 - Grinding & Polishing DATE December 1940.

ACCT. NO.	NAME	STANDARD ALLOWANCE	ACTUAL EXPENSE	GAIN OR LOSS MONTH	GAIN OR LOSS PERIOD
6-1501	Labor - Direct				
1502	Labor - Indirect				
1502	Labor - Indirect - Gen.Plant				
	Total Labor				
1586	Repairs & Maint. - Labor				
	- Material				
	- Overhead				
	Total Repairs & Maint.				
	Total Grinding & Polishing				
	% Gain or Loss				

Every month the control department sends budget statements to each plant, showing how actual expense compared with the budget allowance. Discrepancies are explained on the special form shown on page 96

Sheet #1

MATERIAL				OVERHEAD			TOTAL LABOR, MATERIAL AND OVERHEAD		
GAIN OR LOSS	STANDARD	ACTUAL	GAIN OR LOSS	STANDARD	ACTUAL	GAIN OR LOSS	STANDARD	ACTUAL	GAIN OR LOSS

tact between the control department and the plant, if the actual expense on the monthly budget varies from the standard.

By the twelfth of each month, the control department sends budget statements to each plant, showing how the actual expense for each department compared with the budget allowance. This is done for all cost items, but since we are describing the maintenance budget, only these items will be covered. This report to the plant is in summary form; the plants already have the yearly budget figures in detail, which were set up at the beginning of the year. They also have the detail of the actual expense, which can be traced back through departmental account numbers to the individual maintenance and work orders. They are in a position, consequently, to prepare an explanation of why a discrepancy arose. Each department that has a discrepancy to explain, uses a form designed for this purpose, which is returned to the control department with the detail noted.

These explanations are filed by departments, and are available for the budget meetings with individual plant departments at the time the budget is set for the succeeding year.

If, for example, an operating department should, in the yearly budget meeting, desire to increase the budget allowance for maintenance and repair, because it wishes to overhaul a conveyor, the control department would be in a position to call attention to the fact that the conveyor had been overhauled during the current year, and that this explanation was given for exceeding the budget in the particular month in which it occurred. Obviously, if the conveyor needed overhauling, it would be done, but the control department can raise the question of advisability, which, after all, is the *sine qua non* of budget control.

Each Item Budgeted

The control department sends to the plants a statement of each individual item of expense budgeted to each department for the past three years. Maintenance is divided into labor, material, and overhead. There is included also a summary of all special requests, extra allowances, etc., mentioned on the budget sheets, made during these same three years. This information, together with the explanations of budget variations, affords a complete and satisfactory basis, when tempered by operating knowledge of current conditions, for setting a practical yearly maintenance budget.

Since this plan has been in operation for only ten years, detailed savings as a result of it cannot be given. We do, however, have a precise control of every expense in every department, and that includes the highly variable maintenance expenses, admittedly difficult to control. Moreover, each expense in every departmental budget must stand on its own, because every item for which a departmental supervisor is responsible, has its own individual budget standard. If any one standard is exceeded in any month, an explanation is in order, even though the total for that department may show a black figure. The supervisor of the maintenance department is held accountable in exactly the same way that an operating supervisor is.

The detail involved in setting up and operating our maintenance budget may appear to be excessive. In reality it is not. Little additional effort is required above that needed for the accounting verification of labor and material.

Brief Summary

Let us summarize briefly what is involved. From the control department to the plants goes, first, the three-year summary of all expense for each department each year; second, the monthly summary comparison of actual expense with budget standards. From the plant to the control department comes the monthly repair and maintenance report of actual cost; the accounting information from operating departments that furnish the units upon which the budget for each department is based—pounds of steam produced in the power house, for example; and, finally, the maintenance labor distribution summary and the maintenance material distribution summary. Also the explanations for variation of actual from standard.

LIBBEY-OWENS-FORD GLASS COMPANY
Plant No. 6 - Rossford

Sheet No. 1

Department No. 6-1500 Grinding & Polishing

Month of December 19 40

Acct. No.	Name	Standard Allowance	Actual Expense	Gain or **Loss	*Explanation of Gain or Loss
6-1520A	Plaster - Second Side	X	X	X	Reasons for gains or losses
					are explained in this column.
6-1520B	Lime	X	X	X	
6-1540D	Tools	X	X	X	
6-1586	Repairs and Maintenance	X	X	X	

*See other side of sheet for Instructions on use of form.
**Show losses in red

Submitted By John Doe

When a discrepancy between actual and budgeted expense appears, a special form for explanations is used

SELECTION • INSTALLATION • INSPECTION • UPKEEP • ORGANIZATION

When Unit Heaters Go to Work

Better be sure they have been properly selected and installed, are in good condition. Check the effect of any changes in the area heated that may influence the flow of air

EDWARD H. HUBERT, Industrial Heating Engineer, L. J. Wing Manufacturing Company, New York

USE MADE OF THE AREA to be heated is the primary factor that should influence the choice of unit heaters. For example, a large area where rough manual work is done does not require the same temperature as a room in which female workers are seated. There a higher room temperature and even distribution of heat are needed.

Among special conditions that must be considered in selecting equipment are the danger of explosion of fumes or hazardous materials, corrosive atmosphere, or the presence of large quantities of lint, which will quickly clog the ordinary unit heater.

Let Warm Air In

If air is exhausted from the room as in woodworking plants and paint shops, or there is need for special ventilation, provisions must be made for it in selecting heating equipment. It can be done preferably by supplying an equal amount of outside air properly warmed through unit heats of a type that will deliver the air at the proper temperature under widely varying outdoor temperatures, without danger of freezing.

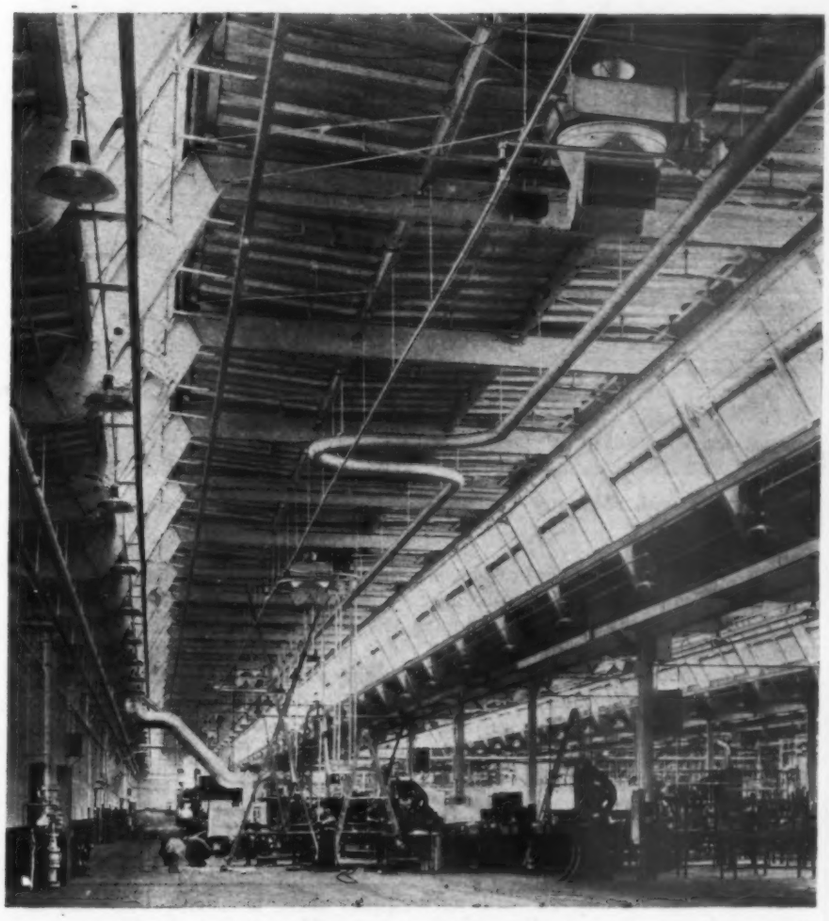
Quietness and freedom from drafts are important requirements in certain instances.

Most important of the general considerations are the physical characteristics of the building or room. Size, shape, height, type of construction, and occupancy largely determine the characteristics of the heater that will be most suitable. Obstructions, such as machinery or materials, must be considered carefully from the standpoint of their effect.

It must be remembered, too, that radical changes, such as he erection or removal of partitions, are likely to create new conditions under which an existing heater installation may or may not function at maximum efficiency. Hence any such alterations must be studied for their effect on heater performance.

The vertical, ceiling-suspended heater with multiple discharge outlets provides the most satisfactory distribution of heat. One such heater is as effective as several one-way heaters. In addition, the overhead unit has the highly desirable ability of preventing the accumulation of hot air overhead and thus eliminates excessive heat losses.

In large, high areas the first rule is, therefore: *Use large units and mount them high.* It is necessary, of course, to employ units that have the ability



Revolving discharge outlets are used on the unit heaters in this large plant

Unit heaters with four-way discharge outlets heat a long loading platform

to deliver the air to the working level from the high mounting. Units are available that will cover large floor areas and operate successfully at practically any mounting height encountered in modern buildings. For instance, there are successful installations of heaters mounted 65 feet above the floor.

For low ceilings, smaller heaters covering less area are employed. One reason for using small heaters with low ceilings is to assure that a large stream of high-velocity air will not strike workers and cause discomfort. Small air streams directed horizontally, so that they do not touch people at close range, are the proper choice.

A vertical heater with a multiple discharge outlet that slowly revolves, produces draftless distribution. The air streams sweep slowly around, quickly moving away from any one worker, so that no one feels the unpleasant sensation of a continuous blast of air.

In small rooms it is often undesirable to mount a heater overhead in the center of the space. Moreover, in such spaces there is usually only one exposure. Here it is preferable to use a heater of the type that discharges air in one generally horizontal direction. This unit should be mounted on one of the walls.

Evenness of heat distribution is another characteristic that must be studied in selecting a heater. Equal temperature at all points is desirable under almost all conditions where people are present.

The revolving type of discharge outlet, which keeps the air constantly in gentle turbulence, provides equalized temperature. It is to be recommended where workers are seated, doing no manual labor.

Where even heating is not so necessary, other types of discharge outlet on overhead units will give satisfactory results, depending on the shape of the outlets. In order to assure that the warmed air will reach the floor from a high-mounted heater, and to obtain wide coverage, the outlets should be formed so that they give the required velocity to the air in order to spread it towards the sides of the space to be covered.

In some installations even distribution is not necessary or feasible. In garages, for example, a practical plan is to use a heater without multiple outlets. This heater is mounted above an aisle. The warm air stream is delivered down to the floor where it mushrooms out in all directions, passing underneath vehicles and thus reaching places that would be difficult to heat by any other simple method.

Motor or Turbine

It is often necessary, and usually desirable, to mount the heater where it does not occupy valuable space and will be out of the way of machinery or cranes. The high-mounted, overhead heater offers these advantages.

An electric motor is commonly employed to drive the fan of a unit heater, but in some instances it is advantageous to use turbine drive. This type of drive obviates danger of explosion in hazardous atmospheres. It is also sometimes desirable from the standpoint of overall economy, since the exhaust steam from the turbine is used to heat the air.

A high-pressure steam plant is costly but, if available, high-pressure has one great advantage over low-pressure steam—the piping is smaller and therefore installation costs are smaller. With heaters constructed for its use, pressures up to 200 pounds are commonly employed. The heating surface, of course, must be such that air is not discharged at excessively high temperatures. High-temperature air causes discomfort if it strikes people directly. Furthermore, over-hot air cannot be

projected down any considerable distance to the working level; hence the upper areas will be overheated with consequent loss of heat.

Results may be entirely unsatisfactory, if the heater is not adapted to high-pressure steam. Heaters designed for low pressures cannot be used on high-pressure systems, even though they may be built strong enough to do so.

Low-pressure steam is often used for heating in plants that generate it at high pressure because the exhaust from engines or other equipment is available at low cost.

Better Use Thermostats

Another reason advanced for the use of low-pressure steam in unit heaters is that the condensate is cooler. It is therefore more easily handled than high-temperature condensate, which flashes back to steam when released at low pressure and wastes heat. There are, however, methods of reducing condensate temperature. One good plan is to pass the condensate through one or more unit heaters and use high-pressure steam on the remainder. These condensate units cool the condensate and use the extracted heat to warm the plant.

Steam and return piping must be of adequate size. If steam lines are too small, the heaters will not get sufficient pressure and their output will be reduced. Likewise, when return lines are too small, water remains in the heaters and may limit their output to a serious extent.

All piping must be run with sufficient pitch—usually at least ½ inch in 10 feet.

Successful unit heater operation can be nullified by the use of unsuitable accessory equipment.

Unless condensate and air are eliminated from the heater and piping, sufficient steam will not flow into the heater and its capacity will inevitably be reduced.

The accompanying drawing illustrates the principles to be applied in laying out the piping connections. Particular attention must be paid to traps. For standard unit heaters, the trap must pass both condensate and air, and do it at the steam temperature used. Trap capacity must be based on its use specifically with a unit heater at the steam pressure used. The trap for a unit heater must have three times the capacity of traps handling the same hourly quantity of condensate discharged from some other equipment. Don't select a trap by piping size, such as a "½-in." trap. Traps of identical pipe size have different capacities. Traps should be used at the end of long runs of steam mains. Here they should be connected to drain into the return main all water that has condensed in the steam main. When condensate is allowed to drain through the heaters, water hammer often occurs that will damage them. Furthermore, the capacity of the heaters is reduced.

In a gravity-return system, air valves are important details. One should be located at each heater, one at a point just above each riser, and others wherever accumulated air will prevent free flow of steam.

Thermostat control, although not necessary, is well worth while because of the resulting convenience and economy.

The simplest application, and one that is satisfactory for most conditions, employs a thermostat to start and stop the heater fan. Usually each heater has its own thermostat, which assures the most uniform temperature. In some large installations, however, one thermostat may control a number of heaters. With multiple control particular care must be taken to use the proper protective devices and motor starters with the individual heaters.

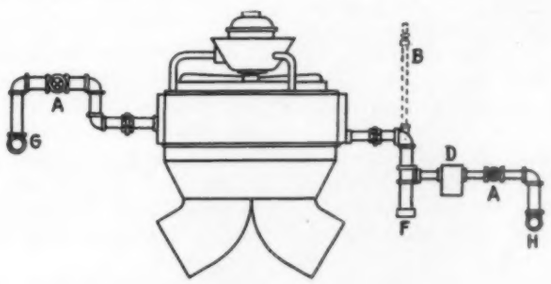
In some installations, especially where oil burners produce the steam, a pressure control is employed to prevent the heater from running when there is no steam in the system. This control is needed because there is sometimes a lag between the call for heat by the thermostat and the supplying of sufficient steam by the oil-fired boiler.

All discharge outlets should be provided with ample means for adjusting the direction of the air delivered. Vanes on discharge outlets can be adjusted separately to give various desired projections of the warm air. The correct angle depends largely on the distance from the floor at which the heater is mounted. When the heater is high, the angle of delivery must be different from that used when the heater is closer to the floor.

Over Their Heads

Best results can be secured by trial of different settings under operating conditions. A recommended general rule is to set the vanes so that the heated air is just perceptible at the breathing line. For overhead types near walls a method that often gives

PIPING FOR UNIT HEATERS



A—Globe or gate valve.

B—Quick-vent air valve (use only with closed-return systems).

D—Trap (use only on dry-return systems).

F—Dirt pocket.

G—Steam main.

H—Return main.

For free expansion of mains use double elbows or long branches between mains and heater.

good results is to direct the air against the walls above the heads of the workers.

All adjustment nuts should be kept tight to prevent rattles.

A check of the heaters and systems should be made before they are put into operation. In general, the same steps should be taken that are outlined later.

The fan must turn with the proper rotation. Upon starting the fan, the air direction can be quickly felt. If the direction is wrong, it may be reversed by following the connection diagram that accompanies the heater. (It is sometimes placed, for protection, under the condulet cover of the motor or controller.)

All controls including switches, thermostats, speed changers, should be tested.

Proper steam pressure must be maintained at the heater when the whole system is operating. Too-low pressure may be caused by (1) too small a boiler, (2) boiler not operating correctly or at full capacity, (3) too small piping, (4) valves partly closed.

For Cooling, Too

Air in pipes or heater will decrease heat output. For gravity-return systems good air valves, properly located, are the remedy.

Water in steam pipes or heaters will limit capacity. Proper traps and sufficient pitch to piping will eliminate this trouble. Sometimes the level at which a heater is mounted is so close to boiler-water level that good drainage of condensate is difficult or impossible to obtain.

Entrance into the building of excessive amounts of cold air may keep the temperature too low, even when the heating system is operating correctly. Such leakage of air may be caused by open doors, windows, or ventilators that should be closed in cold weather, or by exhaust systems whose operation draws in cold air to replace the exhausted air. Where a considerable volume of air must be exhausted, provision should be made to take in fresh air through a heater that warms it to a comfortable temperature, before it is discharged into the heated area.

Many plants operate their unit heaters in warm weather, with the steam shut off, and thus get the benefit of the cooling sensation produced by air motion.

If pressure controls are installed, they must be cut out of service when heater fans are operated to create circulation of the air. Such controls are normally connected to open the motor circuit when pressure drops, and thus stop the motor. In order to make the fan run when steam is not being supplied, the connections must be changed to prevent the opening of the circuit.

Unit heaters should be examined and the necessary small amount of maintenance taken care of once a year if they are used for heating only, or twice a year if they are operated constantly.

This Maintenance Needed

A heater fan can inflict serious injury when turning at high speed and it must be remembered that the fan cannot be easily seen. Therefore, be sure that the fan is stopped before making any inspections, and take strict precautions to prevent the fan being started either by some person or by automatic control.

Parts to be inspected and the steps to be taken are as follows:

Heating Element. Inspect the heating element or coils and remove any dirt or obstruction that might restrict free flow of air. Compressed air is sometimes used for this purpose, blowing through the element in the direction opposite to normal air flow. When properly used this is a simple and effective method of cleaning these parts.

Fan. Spin the fan by hand to make sure that it turns freely, and see that the setscrew is tight. Clean off all dirt and lint.

Lubrication. Lubricate once a year if the unit is used only during the heating season. If used summer and winter, lubricate every six or eight months.

Ball-bearing motors should have grease added when the motor is cold. Do not add too much grease because an excess will prevent the bearings from turning freely and cause them to overheat. The motor shaft should turn easily by hand after the bearings have been greased.

Use a high-grade grease that will withstand the temperature to which the motor is subjected. Remember that the motor temperature will be higher than that of the room and that grease especially suitable for high temperature is essential, if trouble is to be avoided.

Sleeve-bearing motors should be oiled every three or four months during operation. Do not flood the bearings, because an excess of oil will flow into the winding of the motor and tend to injure it.

Motors. Motors should be cleaned of dirt and oil at the beginning of each heating season. Clean the commutators carefully and thoroughly with fine sandpaper and a dry cloth. Brushes require cleaning so that they move freely in the holder. Adjust springs so that the tension just holds the brush firmly on the commutator. Too much pressure on the brushes is undesirable.

Clean centrifugal switches and short-circuiting devices occasionally and brighten the contacts with fine sandpaper.

It is good practice to take motors apart every two or three years and clean them thoroughly inside and outside.

Worn bearings should be replaced. Don't wait until they let the rotor down far enough to drag.

Wash out ball bearings with gasoline and supply them with fresh grease after all gasoline has been removed. Wool-packed bearings should be washed and fresh wool put in or the original wool cleaned of dirt and grit.

Put covers of bearings and grease cups in place to exclude dirt from the bearings.

Remove all dirt from the windings of the motor. It is well to apply a coat of good insulating varnish.

Vanes. Adjust vanes on discharge outlets as explained previously.

Electrical Controls. Check thermostat and pressure control settings.

Controls should be tried for operation. Contacts should be cleaned, springs adjusted, and connections tightened.

If motor wiring has been disturbed, see that the direction of rotation of the fan is correct.

Piping and Fittings. Clean and check traps, sediment pockets, and air valves. See that pipe joints and valve stems are tight, especially on a vacuum system. All hand valves should be opened fully.

Ducts. If the heater is connected to a duct, see that no obstruction is present in the duct or its openings. Damper settings should be checked on stationary dampers. Check the action of automatic moving dampers to make sure that they operate properly.

Casing and Hangers. To prevent rattling, all screws and bolts in the heater case and the hangers should be kept tight.

Use the Exide System

...and your batteries will last longer...

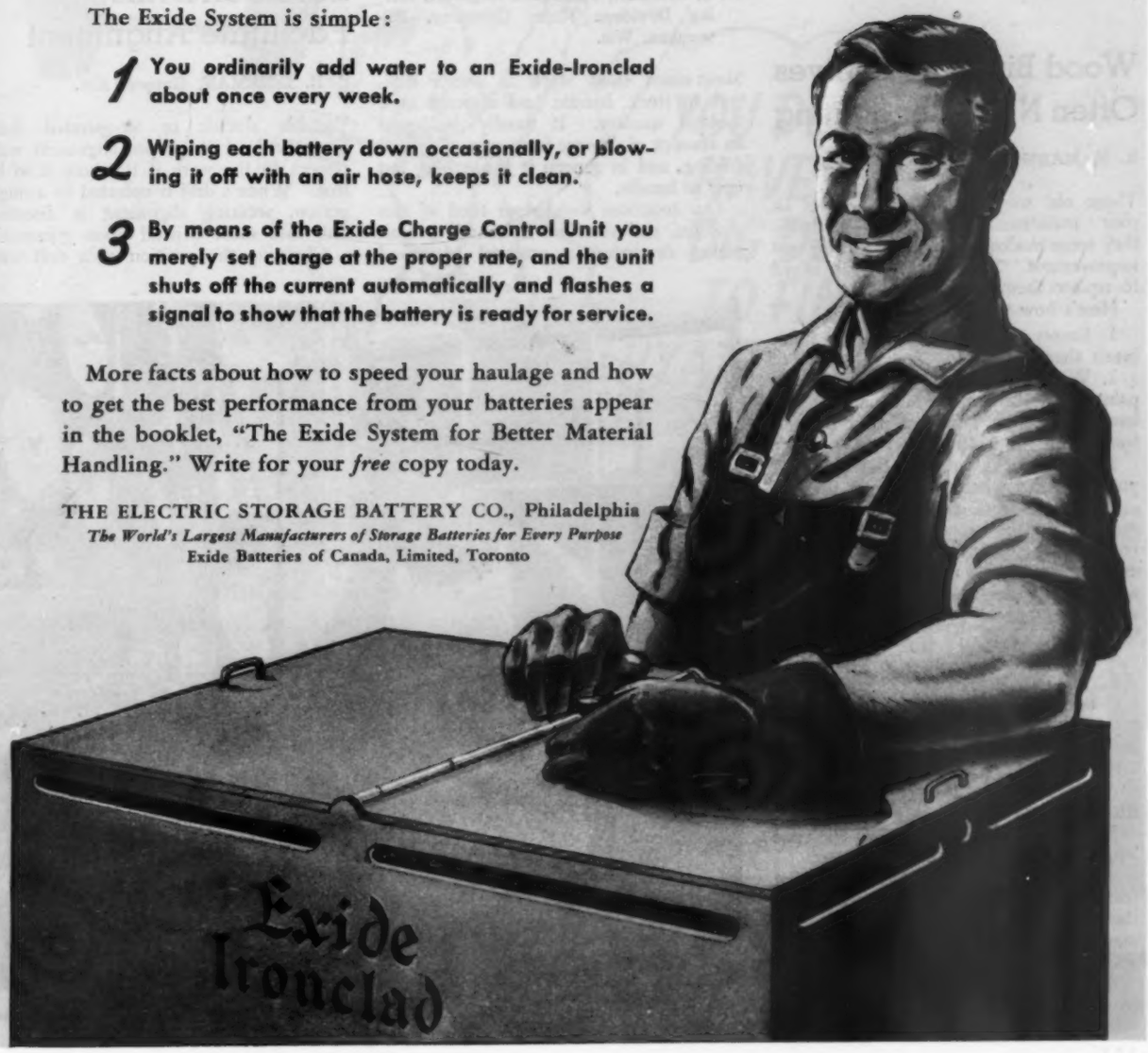
IN THESE TIMES of "blitz-production" you can cut replacement costs and make your batteries last far longer if you use the Exide System to keep them in good shape.

The Exide System is simple:

1. **You ordinarily add water to an Exide-Ironclad about once every week.**
2. **Wiping each battery down occasionally, or blowing it off with an air hose, keeps it clean.**
3. **By means of the Exide Charge Control Unit you merely set charge at the proper rate, and the unit shuts off the current automatically and flashes a signal to show that the battery is ready for service.**

More facts about how to speed your haulage and how to get the best performance from your batteries appear in the booklet, "The Exide System for Better Material Handling." Write for your *free* copy today.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto



MAINTENANCE SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

BUILDINGS, SERVICES, MAINTENANCE

Eraser Is Good Cleaner for Control Contacts

CARROLL S. KINNEY, San Jose, Calif.

I find the use of a stenographer's abrasive eraser (the round type with brush attached) extremely useful in keeping light control relay contacts clean. The eraser is sufficiently abrasive to clean up the contacts where not severely burned, and yet leaves a clean smooth surface. They are also useful in furnishing a contact cleaning where a heavier abrasive is necessary.

•

Wood Bins and Shelves Often Need Renovating

R. N. MARSHALL, Mt. Holly, N. J.

Those old wooden bins and shelves in your maintenance storeroom—probably they seem inadequate, sloppy, and beyond improvement. Sometimes you can afford to replace them; sometimes not.

Here's how to fix them up:

1. Empty everything out on the floor; brush them out clean.
2. With a spray gun and some white paint, spray them inside and out. If you haven't the spray gun, just paint the bin fronts with the white paint.
3. Separate the parts on the floor and put back only what you actually need.
4. Borrow from the shipping department an alphabet stencil and stencil brush (or simpler yet, borrow their shipment marking pencil—you know, the one they write order numbers on crates with) and write the contents of the bin on each bin front.

You'll discover that:

1. You'll have enough old iron, brass, and empty cartons left on the floor to give the scrap dealer a field day, and, incidentally, to pay for some of your renovating expense.
2. You'll have a neat, airy, and clean storeroom.
3. Your men won't spend half the time looking for things.
4. You'll have space to spare, so that you can bring outlying sub-storerooms into the extra space. You'll be surprised how many bins formerly were filled with empty cartons, old rags, and stray bolts.
5. You can see the labels on the bins from a distance. No longer need you decipher smudged paper tags. It'll be easy to take inventory, too, because you're pretty sure everything of a kind is in one bin only.
6. When you discontinue certain items in the future, rub off the old label lightly with thinner, and stencil or write the new label.

•

Makes Shim Stock Easy to Handle

W. S. HANSEN, Production Engineer, Harley Davidson Motor Company, Milwaukee, Wis.

Sheet-metal shim stock is always difficult to stock, handle, and dispense at a toolcrib window. It usually undergoes an amount of damage from crumpling and folding, and in general it is anything but easy to handle.

Our toolroom storekeeper tired of this disorder, and since he is himself a toolmaker developed a practical idea and worked it out with his hands. High up at the top of a shelf rack he fastened two hardwood 1x2-in. boards, 6 inches wide, with two wingnut bolts, so that they can be pulled tightly together by hand. He simply slips the shim stock—which comes in 6-in. widths—between these two boards and clamps them together with his wingnuts. In the adjacent toolbin he keeps his tinshears.

Thus, the sheet stock hangs flat on the end of the bin, like so many sheets of paper. As it is ordered he cuts off what he needs, and hands it out to the workmen at the window.

•

Levels on Drills Facilitate Alignment

S. H. COLEMAN, Gorgas, Ala.

Portable electric or air-operated drills must be held in proper alignment with respect to the work if the hole is to be true. When a drill is operated by a single person, securing alignment is direction only and must depend upon guesswork.

Checking the position of a drill with

By letting shim stock hang free, it stays straight and can be easily cut off as needed

KEEP THEM YOUNG WITH HYATTS

Built by SERVICE CASTER & TRUCK COMPANY, Albion, Michigan, are these fleets of Hyatt equipped trailers serving industry everywhere.

ALL THE WAY THROUGH—from our exacting steel specifications, positive controlled heat treating, exclusive precision grinding methods, unrelenting process and finished product inspections — quality is built into Hyatt Roller Bearings to make them perform so well and so long. Are you enjoying the advantages of Hyatt Quality in the equipment you build or buy?

Tell us when and where we can serve you. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N.J., Chicago, Pittsburgh, Detroit, San Francisco.

HYATT

ROLLER BEARINGS

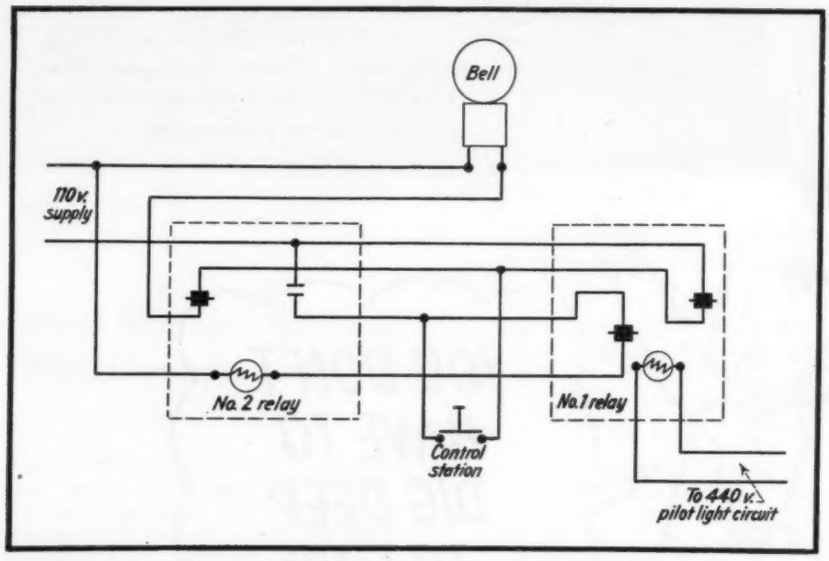
QUIET

a square and spirit level gives quite accurate results but it requires two persons, one to handle the drill and the other the aligning tools, and therefore is impractical in most instances.

A simple way of accomplishing the same results is to mount permanently two or more spirit levels on the motor housing. If much drilling requiring a fairly high degree of accuracy is to be done a square mounted in slip guides on the motor can also be used. For alignment when the drill is pointing straight up or down two levels mounted at right angles to each other will be sufficient. The ends of the levels should be held in brackets so that they can be revolved to make the bubble readable with accuracy in either of the two positions.

Ordinary line levels costing less than a dollar apiece are suitable if correctly installed and checked with a larger level.

POWER, HEAT, AIR CONDITIONING



Failure of power in the motor circuit causes bell to ring. Pushbutton cuts it out

Alarm Bell Tells When Pump Motor Stops

E. V. YOUNG, Chief Electrician, Columbia River Paper Mills, Vancouver, Wash.

Occasional stopping of a motor-driven pump located on the ground floor of one of our departments and controlled from the third floor by a pushbutton station causes considerable trouble because the liquid that is handled backs up and plugs the lines. A pilot light is included in the control station, but unless the operator happened to be looking directly at it, stopping of the motor would go unnoticed. An audible signal was desirable, therefore I installed a bell, control button, and the necessary control relays as shown in the sketch. To do so I used two small relays that we had on hand. However, parts of old contactors could be used with coils designed for the voltages available, with equally satisfactory results.

The pump motor operates on 440 volts and the bell on 110 volts. No. 1 relay has its coil energized from the 440-volt pilot light circuit and has two normally open contacts. No. 2 relay has one open and one closed contact with its coil energized from the 110-volt bell circuit. Failure of power in the pilot light circuit deenergizes coil of relay No. 1 and closes its contacts completing circuit through bell and also to bell control station. Pushing the button energizes coil of relay No. 2, opens its contact in bell circuit, and closes contact shunted across control station contacts. Starting up pump energizes coil of relay No. 1 and opens its contact, releasing coil of No. 2 relay.

The control button is used to stop the bell from ringing when the pump is down over the weekend and during repair and clean-out periods.

•

Short pieces of tinned, hard-tempered copper tubing had been regarded as scrap. It was found they would be used if they could be annealed, but a furnace would spoil the tinning. A spot welder with points contacting ends of the tubing did the trick.

•

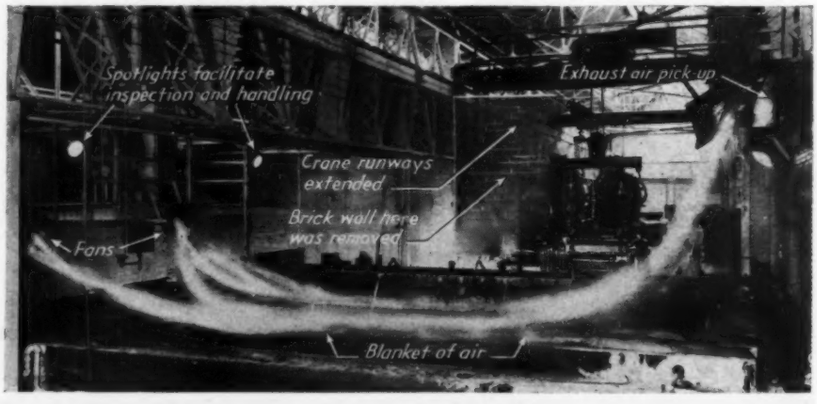
"Aired" Pickling Room Is Good Place to Work

SOURCE—Truscon Steel Company, Cleveland, Ohio

Once the toughest spot in the plant to work because of fumes from 16,700 gallons of 6 to 8 percent sulphuric acid pickling solution, the pickling room at this plant got a thorough "airing" just a few short months ago.

Two 24-in. motor-driven fans were installed to direct their air streams downward at a 45-deg. angle on the liquid; they sweep the fumes across 33 feet of open tank surface to an exhaust fan pick-up on the opposite side.

So thoroughly is the ventilating job done that a brick wall separating pickling from blanking department could be torn down, overhead crane runways extended into the next room and a 10-ft. section of 44-in. roller conveyor installed at the discharge end of the pickling tank to receive sheets, stampings, and other material as it is picked out of the tank at end of pickling operation by the 10-ton overhead crane.



Two 24-in. fans at left and exhaust fan at right combine to sweep out picking fumes

Why everyone with a hand in plant piping prefers

TUBE-TURN *Welding Fittings*

Naturally, you are *most* interested in the particular ways that Tube-Turns help *your* department and *your* problems. You'll find them in the above illustration.

But go further. Note the equally strong advantages that Tube-Turn welding fittings offer to *all* departments in your plant that are concerned with piping.

By viewing here *all sides* of the Tube-Turn story, you see *why* Tube-Turns have earned ever-increasing preference—constantly wider applications—and the leadership held since their *origination* of the welding fitting idea.

There's a Tube-Turn for *every* welding fitting need, in all types, sizes and weights. Write for helpful catalog and data book. TUBE-TURNS, Inc., Louisville, Ky. Branch offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Los Angeles. Distributors everywhere.

TUBE-TURN TRADE MARK

★ The ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST

Welding Fittings

Fluorescent Lamp Troubles: Causes and Remedies

L. R. KEIFFER, General Electric Company, Nela Park Engineering Department, Cleveland

Failure of a fluorescent lamp to start and operate properly may be due to a number of causes. Assuming that the lamp itself is in normally perfect condition, the starter and ballast, for example, may be of improper design or rating, or they may fail to operate properly. The automatic starting switch must close and open properly, and pass enough current through the filament electrodes for the time needed to preheat them sufficiently.

It is the function of the ballast to deliver the proper voltage and current, of one value for starting and another for operation. It must also limit the current to the value required by the lamp under normal operating conditions.

Assuming that these devices are suited to the application and are in good condition, proper functioning is dependent on whether the voltage is within certain limits.

Fluorescent lamps have a rated average life of 2,500 hours, although some lamps may fail after a few hundred hours, whereas others may last 4,000 or 5,000 hours. In any event the lamps gradually deteriorate while in service, thereby causing certain symptoms or troubles.

Causes and remedies for common troubles are given in the following tables:

Table I. Starting Difficulties*

Symptoms	*Possible Causes*	*Remedies*
Blinking on and off of an old lamp. (Often accompanied by "shimmering" effect.)	Normal failure due to exhaustion of active material on electrodes	Replace lamp, removing old one promptly
Blinking on and off of a relatively new lamp	1. Lamp may be at fault	Replace lamp. Investigate lampholders
(One factor or a combination of factors may cause blinking of a relatively new lamp. Under limiting conditions of starting or operation, replacing either a lamp or starter with one of slightly different rating may temporarily correct a difficulty due to some other cause. Therefore careful consideration should be given to all the various factors in case of unusual difficulty.)	2. Defective starter may cause blinking or prolonged flashing at each start	Replace starter
	3. Low-temperature operation	Keep voltage up. Use thermal switch auxiliaries
	4. Ballast low in rating	Check ballast and replace if necessary
	5. Cold drafts	Inclose lamps
	6. Loose circuit contacts (likely at lampholders)	Make sure that lamps are securely seated and lampholders are rigidly mounted
	7. Low circuit voltage	Check voltage and boost if possible
	8. Improper circuit connections	Correct connections
Lamp makes no starting effort	1. Lamp not making proper contact	Seat lamp properly
	2. Starter may not seat properly in starter socket	Try another starter. In new installation, starter socket may be at fault
	3. Lamp has open electrode circuit	Replace lamp
	4. Lamp has leaked air	Replace lamp
	5. Starter has reached end of life	Replace starter
	6. Ballast defective	Replace ballast
	7. Improper wiring	Make proper connections
Lamp is slow in starting	1. Sluggish starter	Replace starter
	2. No starting compensator in leading branch of two-lamp ballast circuit	Install compensator in series with leading circuit starter. (65- and 100-watt two-lamp ballasts need no compensators.)
	3. Low line voltage	Check voltage and correct if possible
	4. Low ballast rating	Replace ballast

*Correct trouble at once or remove lamp or starter to avoid damage to lamp, starter, or ballast.

(Continued on page 108)

You look for FRESHNESS...

for a better smoke... That's why cigarettes are sealed in moisture-proof Cellophane

You look for FRESHNESS...

for better flavor... That's why candies are sealed in moisture-proof Cellophane

NOW

LOOK FOR FRESHNESS IN TAPE

SEALED IN *Moisture Proof* CELLOPHANE

FOR TIME-SAVING APPLICATION

FOR BETTER ADHESION

FOR CLEAN, STRONG TAPING JOBS

Every package of GRAYBAR tape will soon come to you in a glistening wrap of moisture-proof Cellophane. Thus, it will be virtually *factory fresh* right up to the time you open the package.

Every one who has ever used tape knows the time-saving advantages of the extra adhesiveness you get with factory-fresh tape. And when the roll inside the package is GRAYBAR tape, you're equally sure of extra strength, and freedom from pinholes or ravelling on the edges. For a clean, permanent taping job... one that holds its adhesion longer on the joint... be sure you get one of these GRAYBAR brands in the new Cellophane wrapped package.

GRAYBAR AMAZON

Friction Tape – A high quality tape meeting ASTM and Government Specifications. Guaranteed minimum footage—82½ feet.

Rubber Tape—A highly elastic rubber tape for severe service. Guaranteed minimum footage —30 feet.

GRAYBAR VICTOR

Rubber Tape – An unusual value, second in quality only to Amazon brand. Withstands 300 volts per mil of thickness. Guaranteed minimum footage—21 feet.

GRAYBAR VICTOR

Friction Tape – A high grade tape for general commercial service, with a strong tacky friction. Guaranteed minimum footage – 68 feet.

GRAYBAR STICKA

A popular priced tape suitable for ordinary service. Provides good friction, with compound worked thoroughly into the cloth. Guaranteed minimum footage—60 ft.

... all manufactured to Graybar quality standards by Boston Woven Hose and Rubber Company, Cambridge, Mass.

GRAYBAR ELECTRIC COMPANY

In Over 80 Principal Cities

Executive Offices:
Graybar Building, New York

Fluorescent Lamp Troubles: Causes and Remedies

(Continued from page 106)

Ends of the lamp remain lighted	1. If new installation, wiring connections may be incorrect	Make proper connections
	2. Short circuit in starter. (Starters in use for some time may fail in this way.)	Replace starter

Table II. Lamp Performance

Symptoms	*Possible Causes*	*Remedies*
Early end blackening*	1. Omission of starting compensator where required	Install a compensator
	2. Defective starter causing blinking, prolonged flashing, or ends of lamp to remain lighted	Replace starter
	3. High or low voltage	Keep voltage within ballast rating
	4. Loose contacts (most likely at lampholders), causing lamp to blink	Lampholders should be rigidly mounted and properly spaced. See that lamps are securely seated.
	5. Improperly designed ballasts or ballasts outside specification limits	Use of approved ballasts will usually eliminate troubles of this nature
Normal end blackening*	1. Normal development throughout life. Appears at one or both ends. Usually extends 2 or 3 inches from base	
	2. Mercury deposit at ends	Should evaporate as lamp is operated
Dark streaks lengthwise of lamp tube	Small globules of mercury collecting on lower, or cooler, part of tube	Rotating lamp 180 degrees in lampholders may favor evaporation, although mercury may condense out again
Brownish ring at one or both ends*	Frequently a natural development	Replace lamp if appearance is too objectionable
Dense black spots near ends of lamp	Usually about ½ inch wide and centered about 1 inch from base. Normal development if occurring late in life, but if early in life indicates excessive starting or operating current	If early in life, check for ballast off rating or unusually high circuit voltage
Short life	1. Effect of mortality laws. Some lamps may fail after a few hundred hours, will be balanced by others that live longer than rating	
	2. Frequent starting	Rated life should be obtained on the average if lamps are operated for normal periods of three or four hours
	3. Excessive under- or over-voltage	Maintain voltage within ballast rating
Burned-out electrodes (Insufficient current can be drawn from the ballast to burn out the electrodes under normal conditions.)	1. Improper ballast equipment for direct-current operation	Use special ballast equipment designed for that purpose
	2. Grounded starter socket, grounded lead, wire of stranded lead touching grounded fixture, broken socket	Correct the fault
	3. Connecting direct to circuit without ballast	Install proper ballast

*At the end of their life, lamps usually show a dense blackening at one or both ends. Also, there may be dark rings slightly brownish in color at one end or both. On the average, there should be little indication of either blackening or rings during the first 500 hours.

(Continued on page 110)

Safe—easily matched!
Study the matching of the diamonds on this factory floor. See how "A. W." Rolled Steel Floor Plate presents a uniform pattern over the entire floor—safe for foot or wheel traffic. No cracks or ridges. No worn or slippery surfaces. "A. W." Floor Plate can be cut to any shape and installed without disturbing production. Fire-proof, oil-proof, heat-proof, crack-proof. Easy to clean, quick to drain. Made in five patterns —the Super-Diamond Pattern is shown here. Write for illustrated folder.
"A. W." Rolled Steel
FLOOR PLATE
ALAN WOOD STEEL CO., CONSHOHOCKEN, PA.
District Offices and Representatives—Philadelphia, New York, Boston, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, New Orleans, Pittsburgh, Roanoke, Sanford, N.C., St. Paul, St. Louis, Los Angeles, San Francisco, Seattle, Montreal.

Fluorescent Lamp Troubles: Causes and Remedies

(*Continued from page* 108)

Flicker (swirling, spiraling, and snaking)	1. New lamp may flicker in this manner when first placed in service	Will usually clear up after lamp has been operated for short period or turned on and off a few times
	2. Lamp starting with improper electrode preheating	Replace starter
	3. Omission of starting compensator necessary with certain two-lamp ballasts	Install compensator
	4. High-voltage starting	Check voltage
	5. Starting the lamp with improper auxiliary equipment	Use approved equipment

Table III. Light Output

Symptoms	*Possible Causes*	*Remedies*
Rapid initial depreciation in light output	Normal loss during first 100 hours may amount to as much as 10 percent. (Light output at 100 hours used for rating.)	
Decreased light output	1. Cold drafts	Inclose or protect lamps
	2. Operated at too high a temperature	Better ventilation of fixture
	3. Low temperature. (Below 65 degrees Fahrenheit the light output may drop 1 percent or more per degree.)	Inclose lamp or conserve heat by other means
	4. Low circuit voltage (about 1 percent drop for each percent under voltage.)	Maintain voltage
	5. Dust or dirt on lamp fixture, walls, and ceiling will reduce illumination level	Clean at regular intervals
Color differences	1. May be due to reflector finish, wall finish, other nearby light, room decorations	Interchange the lamps before forming a conclusion
	2. The eye is quite critical in color comparison, and differences within manufacturing tolerances of both white and daylight lamps may be discernible, although the difference should not be objectionable	
Dark section of tube on direct current	Longer lamps especially may develop a region from one-third to one-half the length of the tube which emits no light. It is due to current flowing only in one direction	Install reversing switches and reverse connections in circuit about twice a day

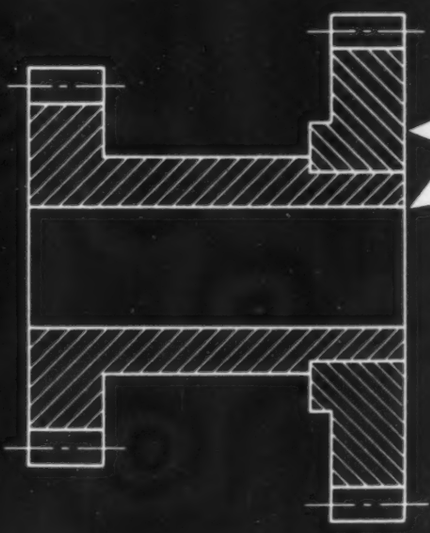
Table IV. Miscellaneous

Symptoms	*Possible Causes*	*Remedies*
Radio interference	1. Bulb radiation	Locate aerial at least 9 feet from the lamp if possible. If not, shield aerial lead-in wire, provide good ground, keep aerial proper out of bulb and line radiation range
	2. Line radiation	Apply line filter at lamp or fixture*
	3. Line feedback	Apply line filter at lamp or fixture*
Hum	Inherent magnetic action in ballast. It is aggravated when these vibrations are transferred to channel or supporting members	Mount ballasts on soft rubber, or other damping material

* In certain cases it may be possible to minimize radio interference by applying filters at the radio power outlet or at the circuit panel box.

Sunnen Honing Solves Another Problem!

SUNNEN *Precision* HONING MACHINE



PROBLEM . . .

A leading manufacturer of machine tools was faced with the problem of hole closing in when gear was pressed on, causing taper of .001" to .0015". Production set up, indicating and grinding out taper required 30 minutes per gear.

SUNNEN SOLUTION

Gear hub is now honed on Sunnen Precision Honing Machine—and since it requires no set up or locating time—it handles this job in 3 minutes—an increase in production of 1,000%.

Low in Cost . . .
Easy to Use

For holes .185" to 2.400".

Accuracy within .0001" guaranteed.

Machine can be set up and work located ready for honing in less than one minute.

Facilitates accurate duplication of sizes.

This is just one example of hundreds of problems being solved by Sunnen Honing.

If you have a job requiring the sizing or finishing of internal cylindrical surfaces from .185" to 2.400" with super-smooth finish and within precision limits, the Sunnen Precision Honing Machine will

SOLVE FIVE IMPORTANT PROBLEMS

1. Corrects errors of out-of-roundness and taper produced by previous operations
2. Produces super-smooth surface finishes
3. Finishes holes to close tolerances both as to size and straightness
4. Maintains alignment established by previous operation
5. Provides simple, low cost production method of duplicating sizes accurately.

DOES NOT REQUIRE SKILLED LABOR

Any intelligent workman with a few hours practice can produce super-smooth finishes and hold accuracy within .0001".

WRITE FOR 8-PAGE BULLETIN — or if you prefer a sales engineer will be glad to call and demonstrate in your plant on your job just what this machine can do for you.

SUNNEN PRODUCTS COMPANY
7938 Manchester Avenue, St. Louis, Missouri
Canadian Factory: Chatham, Ontario

SUNNEN

"A perfectly straight round hole with a mirror finish."

Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 inch."

Drawing and Blanking Die "Saves time in producing smooth base metal finish."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

"Strict alignment maintained between two holes."

Rubber Eraser Extrusion Die "Tripled life of extrusion dies."

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

"Produced an extremely accurate and glass-like finish."

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Large local warehouse stocks assure better delivery and service.

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Local representatives estimate, sell and erect fence with local labor.

GREATER STRENGTH

Time-tested construction using full size posts, wire and fittings.

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Copper bearing steel and highest quality galvanizing give longer life.

PROTECTION ENGINEERED

Entire design and construction planned for greatest protection.

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Send for the Fence Catalog which shows Fences for Factories, Institutions, Airports, Playgrounds, Tennis Courts and Residences. The local representative will gladly quote you on Fencing erected complete.

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WICKWIRE *chain link* **FENCE**

YOU WANT TO KNOW

more about the items mentioned on this page

Letters to the addresses given will bring information

• PACK OF TROUBLE is what you can get into should one of your foremen accidentally let a wrong word slip about unions and union organizations. "Primer of Labor Relations" will tell him the situations created by the Wagner Act and policed by the NLRB and thus help him keep straightened out on employer-employee conduct. Single copy, 50c. The Bureau of National Affairs, Inc., 2201 M St., N. W., Washington, D. C.

• ARE YOU WONDERING about what benefits an industrial health program would bring to your plant? Report based on replies from 1,500 companies in 47 states, employing approximately 2,000,000 workers, will tell you what it's done elsewhere. Discusses value, use, age, and cost of plant health programs and physical examination practices. 50c. National Association of Manufacturers, 14 West 49th St., New York.

• IF YOU are looking for ways to impress your employees, especially new ones, with the importance of their individual jobs and of the products they help turn out, to defense, you will find one way in a booklet recently issued by a company that wanted to do just that. The Fafnir Bearing Co., New Britain, Conn.

• ENGINEERS under high pressure will find it easier to write job specifications if they have an electric resistance-welded-tube data chart covering sizes, tolerances, weights per foot, chemical analyses, and physical properties of round tubing, squares, and rectangles hanging handily on the wall. 22x14 inches. Steel & Tubes Division of Republic Steel Corporation, Cleveland.

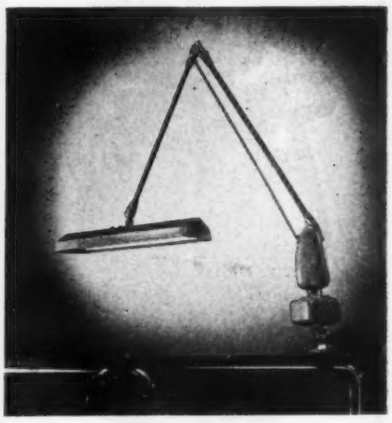
• "WHAT will peace bring," asks a pamphlet discussing possible problems and opportunities of the United States created by the war and our war-changed national policy. Single copy, 10c. Farrel-Birmingham Co., Inc., Ansonia, Conn.

• TO TRAIN welding operators rapidly and to bring modern welding methods before industry, Electric Arc, Inc., of Newark, N. J., has produced two 16-mm. sound films. One stresses the mechanical fundamentals of striking and holding an arc and deposition of metal. The other explains a new method of heating metals "on the spot."

• SELECTING COMPRESSORS for a specific job is simple if you use a compressor selector that works like a slide rule. One movement of the slide and you have model number, r.p.m., free air delivery, piston displacement, and motor horsepower required. Pressures: 30-250 lb. Quincy Compressor Co., Quincy, Ill.

• PAMPHLET, "The Future of Casualty Insurance Rates," discusses trends in pension plans and in group annuity plans, social security act changes, casualty insurance rates and rating methods. 75c. American Management Association, 330 West 42nd St., New York.

• USE of explosive rivets of aluminum alloy (other metals under consideration) is one way to speed up aircraft production. One workman can install 15 to 20 per min. after the holes have been prepared and the rivets placed. They are applicable from one side and their expansion limit can be held to within 20/1,000 inch, it is said. E. I. du Pont de Nemours & Co., Wilmington, Del.



TOUCH IT with a finger and this counterbalanced floating lamp will swing to any position over a desk, table, or workbench that you want it to take. Available in fluorescent or incandescent styles. Dazor Mfg. Co., Duncan & Taylor Aves., St. Louis.

• WHAT the casualty insurance companies are doing and can do for defense is told in "Insurance for the Protection of American Industrial Plants." 50c. American Management Association, 330 West 42nd St., New York.

• THE DANGER in anti-strike laws, a pamphlet explains, is that they may increase rather than curtail the number of strikes. Summarizes a survey of the defense labor problem made by a committee of the Twentieth Century Fund. 10c. Public Affairs Committee, Inc., 30 Rockefeller Plaza, New York.

• SURE WAY of saving time in estimating electrode requirements is provided by a vestpocket Arc Welderule which reads directly the length of arc-welded joints obtainable and also the pounds of

STOPPED
BEARING FAILURES . . . PRODUCTION DELAYS
with SUN H.D. LUBRICANTS
ANOTHER STEP TO A HIGHER P-Q*
Labor, equipment and the right lubricants all functioning at their best is the first step toward increased production—toward the setting of a higher Production Quota (P-Q*).
This was conclusively proved in a large Eastern Rubber Mill. Bearings on large mixers were constantly failing . . . "time-outs" for repairs were crippling production. Many lubricants and many types of bearings were tried . . . all failed to stand up under operating temperatures of 240° F. and pressures of a quarter of a million pounds per square inch.
Then, after a survey by those "doctors of industry"—SUN Oil Engineers—a switch was made to SUN Heavy Duty Lubricants. The problem was solved! There hasn't been a bearing failure since . . . production delays have stopped . . . and a new P-Q* has been set by plant engineers.
Is the P-Q* of your plant as high as it should be? Can these modern, heavy-duty lubricants help you eliminate delays in your plant . . . step up production . . . and permit the setting of a higher P-Q*? Get the answers today, write . . .
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SNIP! and it's CUT

WITH VAN DORN

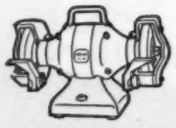
LECTRO-SHEARS

If your plant works sheet metal, let Van Dorn Lectro-Shears step-up your cutting! Give you faster and straighter cuts—sharper and cleaner curves. Portable, compact and light weight, Lectro-Shears accurately follow curved lines, no matter how irregular. Cut on a radius small as ¾". Cutting area always visible.

CAPACITY. Van Dorn's No. 18 Gauge Lectro-Shear (illustrated) handles up to rated capacity in steel and galvanized iron . . . more in copper, aluminum, lead and nonferrous metals. One blade setting for different gauges and types of metal. Ask your jobber to demonstrate the greater speed and precision cutting of Van Dorn Lectro-Shears—or write to us today for complete information.

Other Van Dorn Tools to Speed Up Work

Write today for Free Van Dorn Portable Electric Tool Catalog, describing over a hundred powerful Van Dorn Tools and a thousand different tool accessories for industrial production, plant maintenance, expansion and construction uses. Send for your Free copy now! Address Van Dorn Electric Tools, 719 Joppa Road, Towson, Md.



BENCH GRINDERS

ELECTRIC SANDERS

PORTABLE GRINDERS

ELECTRIC SAWS

"Van Dorn"

(DIV. OF BLACK & DECKER MFG. CO.)

THE "RED HEADED" PORTABLE ELECTRIC TOOLS

weld metal deposited per 100 lb. of electrode. Covers 11 sizes and types of joints, and 22 sizes and types of electrodes in 14- and 18-in. lengths. General Electric Co., Schenectady, N. Y.

• HOW CAN BUSINESS groups legally cooperate to establish joint machinery for the self-policing of unfair or unethical business practices? Recent study on unfair trade practices discusses the question and presents a plan together with comments made by representative trade associations. Committee for Voluntary Control of Unfair Trade Practices, 80 Federal St., Boston.

• WHEN YOU are making and checking calculations for mechanical drawings, laying out machine-shop jobs, and making patterns, and you find yourself tied up adding, subtracting, and converting fractions of an inch, decimals of an inch, and millimeters, you can quicken up the job and do it accurately with a slide rule made for that purpose. Sum-Up Slide Rule Co., 114 Liberty St., New York.

ONE WAY to facilitate training of personnel and recording of minutes at a meeting, is through use of a portable phonographic recording and playing back instrument which records from 31 to 62 minutes of sound on each side of a disk. Disks can be filed for permanent record. Frank Rieber, Inc., Los Angeles.

• POROUS METAL PRODUCT filters foreign materials from oil and other fluids and alters characteristics of gases by diffusion, reducing pressures, and controlling flow rates. It can be bonded to steel and copper and is available in various shapes for use in pumps, fuel lines, lubricating systems, paint sprayers, premixed gas burners, oil burners. Moraine Products Division, General Motors Corp., Dayton, Ohio.

• DEMANDS defense will place on you are discussed in "Guns, Planes, and Your Pocketbook," a pamphlet made available by Public Affairs Committee, Inc., 30 Rockefeller Plaza, New York. 10c.

• IS paint spray booth lighting a problem to you? A special fluorescent spray booth light has been developed by Infra-Red Ray Devices, Inc., 958 East McNichols Road, Detroit, to light the booths coolly and safely. It is equipped with two 40-watt tubes and an air hose fitting which blows paint or gas fumes from the unit.

In addition, you get the value of 61 years'

EXPERIENCE

In making industrial rubber products, too, nothing can ever take the place of experience. Plentiful, first-hand experience is the only source of the "know-how" that makes a belt run right . . . that gives brake lining the right stopping power . . . that enables a hose to deliver full capacity without strains or leaks. And with Thermoid Products you get the benefit of *61 years' experience*—gained in the laboratory, in the factory, and in thousands and thousands of successful installations. Since 1880, Thermoid has been constantly making good products better—and developing new products for new requirements. Whatever your needs in industrial rubber products, it's good business to do business with Thermoid!

THERMOID'S LINE INCLUDES:

Complete V-Belt Drives
Flat Transmission Belting
Conveyor Belting
Elevator Belting
Wrapped and Molded Hose
Sheet and Rod Packings
Industrial Brake Linings and Friction Products
Rubber Covered Rolls
Pulley Lagging

***NEW!* THERMOID V-BELT DRIVE DATA BOOK!**

Thermoid offers a complete V-Belt Drive Service—both belts and sheaves—to cover every possible application, from the smallest F.H.P. drive to the largest multiple-belt installation. Thermoid's new 80-page V-Belt Data Book (just off the press), makes it simple for you to select correctly engineered Thermoid Drives. Be sure to get your copy of this Data Book. See how thoroughly it covers the subject—in a simplified manner that makes the book easy to use.

★ **Thermoid** ★

RUBBER

DIVISION OF THERMOID CO.—TRENTON, N. J.

Install

JOHNSON

Leaded Bronze

BEARINGS

How many "lazy" motors in your shop? Before you blame the equipment . . . check up on the bearings. In order to get maximum power from each unit, it is necessary to install bearings that are designed to *assist* the motor . . . not retard it.

Johnson *Leaded Bronze* Bearings enable you to get the most from your motors. A special high lead bronze alloy . . . plus correct design . . . correct tolerances . . . gives you the long life, the smooth operation and the power you have a right to expect.

Johnson Electric Motor Bearings are available from stock for more than 250 individual types of motors. Twenty-two warehouses plus hundreds of distributors are able to give you excellent delivery. A request, on your business letterhead, will bring a copy of our new, completely illustrated catalogue.

JOHNSON BRONZE

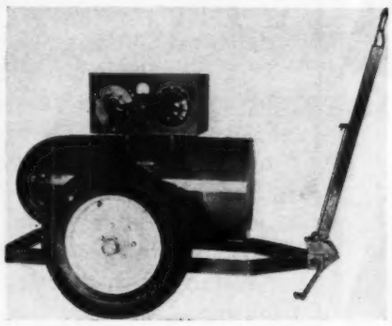
512 SOUTH MILL STREET

NEW CASTLE, PA.

WHAT'S NEW IN EQUIPMENT

Welding Machine Trailer

Two-wheeled, lightweight, pneumatic-tired trailer for mounting arc welding machines for easy, fast portability in shop, yard or on the road. Designed for mounting either Lincoln SAE 200- to 600-amp. a.c. motor-driven, or Type SA 200 special engine-driven Lincoln arc welders, unit can be used for road towing up to approximately



30 miles per hour, can be hitched to a factory mule or industrial truck, and is easily moved by hand. Mounting is accomplished by means of four bolts in frame of trailer which register with holes in lugs on the welding machine. Combination tow bar and standing support has a hand-operated ratchet for locking support arm in position. Unit measures 66 inches long, 42 inches wide, 16 inches high (over tires) and weighs 282 pounds. Tires are 16-inch by 5.50-inch, 4 ply. The Lincoln Electric Co., 12818 Coit Rd., Cleveland.

Fire Protection System

Electrically controlled, thermostatically operated sprinkler system, operating on the rate-of-rise and fixed temperature principle, using a deluge valve controlled by the thermostats to admit water to the sprinkler piping which may be either an open or closed system. Because there is no water in the piping system, danger of breakage because of frozen piping is eliminated. Central Automatic Sprinkler Co., Philadelphia, Pa.

A.C. Tachometer

For use in measuring revolutions per minute, feet per hour, gallons per minute in any manufacturing plant where rotating aquipment is used, alternating current tachometer known as Type A-80, consists of an alternating current generator and a voltmeter of the rectifier type. No brushes or commutator are used in the generator which is of the permanent magnet, a.c. inductor type. Magnets are made of high grade magnet steel and are carefully aged. Rotating element consists of laminated iron keyed to a rust resisting steel shaft. Laminations are slotted to permit variation of the air gap reluctance when the shaft is rotated. This in turn varies the flux linking the voltage coils and induces an alternating voltage in the coils. The alternating voltage is rectified by a Rectox unit in the voltmeter calibrated in r.p.m., feet per hour, or other units depending on the application. Although the best generator speed is 1,000 r.p.m., the tachometer is recommended for operation over a range of from zero to 5,000 r.p.m. This range may be obtained, if necessary, by suitable pulleys, gears, or sprockets. Over-all tachometer accuracy is ½ per cent of full scale. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Barrier Terminal Strips

Barrier terminal strips, series 150, three sizes—150, 151 and 152—have been added to 140 series line. No. 150 has 10-32 screws, with $\frac{5}{8}$ in. metal-to-metal spacing, the No. 151 has 12-32 screws, with $\frac{3}{4}$ in. metal-to-metal spacing, and the No. 152, has $\frac{1}{4}$ in. 28 screws, with 1 in. metal-to-metal spacing. Howard B. Jones, 2300 Wabansia Ave., Chicago, Ill.

Protective Apron

AO Protectocote apron provides protection against acids, oils and greases; also

Slower Aging *is* possible, if . . .

If you'll take advantage of what science has done for oil, you'll keep your machines fit and rarin' to go, month after month . . . . with less failures, less downtime, more production.

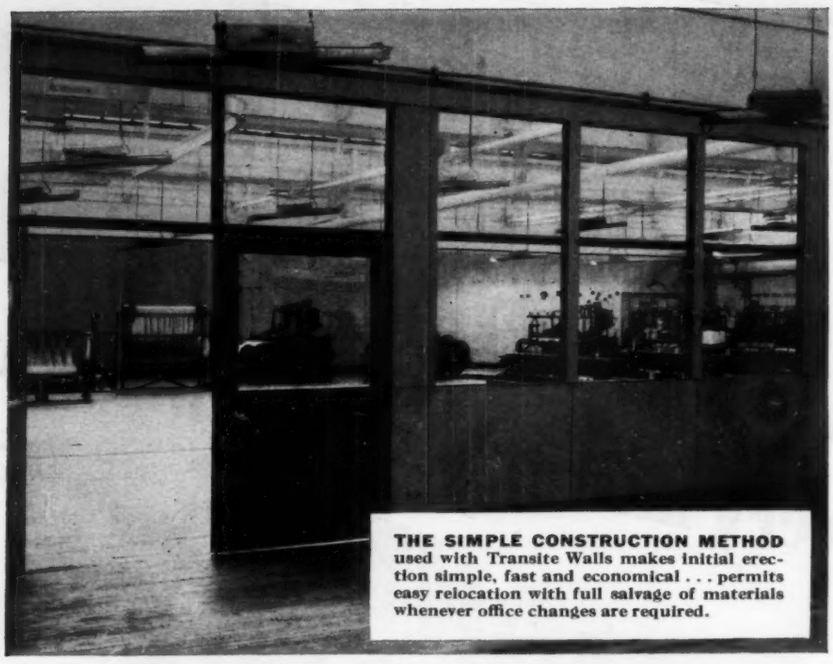
Oils that drip and splatter instead of staying where they belong, will *not* prolong the life of overworked machines. Oils that lack the necessary film strength to resist high pressures and shock loads aren't adequate, either.

But STA-PUT Lubricants, scientifically developed to resist leakage, to adhere to metal surfaces and to increase load carrying capacity, will definitely give your machines that stamina to keep forging ahead under the beating they get today. So in your own best interests, get the Sta-Put record of achievement from the Houghton Man . . . or write direct to—

E. F. HOUGHTON & CO.

Chicago — PHILADELPHIA — Detroit

STA·PUT *Lubricants*



THE SIMPLE CONSTRUCTION METHOD used with Transite Walls makes initial erection simple, fast and economical . . . permits easy relocation with full salvage of materials whenever office changes are required.

When plant offices must be built *FAST*... use J-M TRANSITE WALLS

Easy to install, just as easy to relocate, these asbestos-cement partitions form solid, private offices . . . need little maintenance.

RAPID installation is an outstanding feature of J-M Transite Walls.

Made of asbestos and cement, these modern partitions are supplied in large, light sheets that mean easy, economical handling. A simple construction method cuts installation time far below that required for masonry walls. When alterations are necessary, this same method eliminates dirt and disturbance . . . permits fast relocation of single offices or entire departments. Yet offices are solid and private. And the asbestos-cement composition of Transite Walls provides durability and fire-safety . . . assures continued low maintenance.

• • •

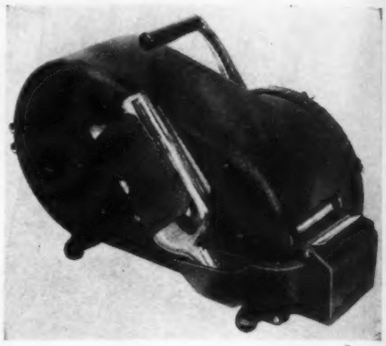
Transite Walls are available in two types, Imperial and Universal. For details on both, send for brochure TR-22A. Address Johns-Manville, 22 East 40th Street, New York, N. Y.

JM Johns-Manville
TRANSITE MOVABLE ASBESTOS WALLS

guards the worker against contact with industrial compounds and liquids that cause skin diseases and discomfort. It resists heat, will not burn. Although tough, it is also light in weight, for comfort and durability. Two styles and 11 sizes. American Optical Company, Southbridge, Mass.

Tape-Moistening Machine

National Tay-Per is a modern tape-cutting and tape-moistening machine which saves tape and time in the shipping room. Its positive automatic moistening feature provides for three positive water level controls, which assure right amount of water



to make tape stick fast. Length-O-Graph determines correctly the length of tape required, preventing waste of tape. Shifting a lever delivers instantly either of two different lengths, which eliminates incorrect cutting. The machine has sharp knife action, cuts quickly and cleanly and will not jam. Nashua Package Sealing Co. Inc., Nashua, N. H.

Level Indicator

Level indicator designed to give constant check on contents of liquids stored in standard 55-gal. steel drums. Level indicator unit screws into faucet opening of the drum and is threaded to receive any type of spigot or faucet using standard type fitting. Amount of liquid in the drum is clearly visible at all times on the glass inclosed gage. Not calibrated to show actual content in gallons, but gage indicates whether drum content stands at "Full," "¾," "½," "¼," or "Empty." Eliminates tapping or measuring to determine the amount of liquid on hand. U. C. Level Indicator, 624 E. Locust St., Milwaukee, Wis.

Water and Dust Tight Circuit Interrupter

Especially designed for disconnecting or interrupting of circuits in outdoor, damp, wet, or dusty locations, non-automatic inclosed De-ion circuit interrupter is designed for use in industrial plants and commercial establishments. Inclosures (NEMA Types 4 and 5) are furnished in either cast aluminum or cast iron, both of which have an aluminized finish. A

I'D RATHER BE RIGHT THAN BE LEFT

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires, and corrects our conscious action.

Sure there's going to be some scrambling when we get back on a 40-hour week. It will be time enough then *to consider whether we'd be right in changing to arc welding.*

ALTER EGO: There won't be time enough then to even consider what hit us.

You mean it will take us a long time to get into welding production?

ALTER EGO: I mean it has taken us far too long already to get into welding *prediction*. Prediction as to what will happen to designs and production methods now that all our friends are going great guns with welding for land, sea and air equipment.

There's no doubt about it, they're getting well up in the welding art.

ALTER EGO: Yes, they're learning the knack in the nick of time. And if we don't have the foresight to get into this *right* away—we'll be *left*, holding the bag . . . on which the closure is foreclosure.

• •

LINCOLN SUGGESTS: The *quickest, surest* way to get things accomplished with welding is: Appoint a man of experience and authority to supervise changeover of one part at a time. If this is done, the problem of how to get going will solve itself. We *guarantee* this plan to be profitable. For details, see Page 1, "How to Change Over to Welded Design for Profits".

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LINCOLN "SHIELD-ARC" WELDING
THE LINCOLN ELECTRIC COMPANY
Cleveland, Ohio
Authoritative Information on Design • Production • Welding Equipment

The handiest reference book—56 pages, indexed for easy use—showing industrial hand tools. Send for a copy of Catalog No. 50 and use it as your guide in buying.

• • •

STANLEY SCREW DRIVERS

Typical of the completeness of each classification of Stanley Tools are Screw Drivers. Shown here are a few of over 200 different screw drivers and bits described in this new catalog. Included is a full line of drivers for "Phillips" Recessed Head Screws and Bolts. Your local distributor will gladly supply Stanley Tools to meet your production and maintenance needs.

STANLEY TOOLS

DIVISION OF THE STANLEY WORKS

151 Elm Street, NEW BRITAIN, CONN.

THE TOOL BOX OF THE WORLD

closely machined fit between handle shaft and bushing with heavy rubber gaskets between inclosure and cover make them water tight. Current ratings range from 50 to 600 amperes, 2 or 3 poles, at 250 to 600 volts a.c. and 125/250 to 250 volts d.c. A high interrupting capacity is provided to interrupt a circuit adjusted for 5,000 to 10,000 amperes depending on frame size. De-ion arc quenchers confine, divide, and extinguish arcs almost instantly as the contacts open thus prolonging contact life. "Quick make," "quick break" action is obtained by a toggle mechanism operating the contacts. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Pumps

Industrial pumps designated types "A" and "T", horizontal pumps are available in all sizes from ¾ in. to 6 in. capacities up to 1,400 g.p.m. and for operating heads up to 100 ft. A variety of materials are used in the construction of these pumps, depending upon the extent of the abrasion or corrosion under which the pump will operate. Features include clamp-bolt construction of the water end, bearing arrangement that assures proper alignment, sealed bearings, readily accessible stuffing box, and self-priming. Four types of impellers are available—2-, 4-, and 6-vane shrouded type and 4-vane open type. American Manganese Steel Division of The American Brake Shoe & Foundry Co., Chicago, Ill.

Gas Cutting Attachment

Rego KXA cutting attachment features: Increased body length of 12 in., plus an extra long high-pressure lever; leak-proof high-pressure oxygen valve action; hard, non-warping, forged alloy head; over-size high-pressure oxygen tube; triangular arrangement of the special alloy tubes to produce maximum strengthened resistance to bending; easy-grip valve wheel, pressure fitted to a non-seizing Monel stem; conical valve stem and seat design permits accurate preheat flame adjustment. KXA uses standard Rego KX cutting tips, fits Rego SX, GX, LGX and XGS welding torch handles, and is available with a 75 or 90 degree head. National Cylinder Gas Co., 205 W. Wacker Dr., Chicago.

Flexible Air Hose

Lightweight air hose so flexible that the ½ inch size can be bent to a 3-in. radius without collapsing or cutting off the air

PLASTICS get a speedy "manicure" . . .

PLASTICS come in great variety. Hardness, softness, brittleness, flexibility, tensile strength and heat-resistance complicate working factors.

There is a "best" way of dealing with each in the finishing of molded parts. Nicholson has made a deep study of the filing operations. For long-range speed — as in flash removal — you need files with very sharp thin-topped teeth for long-lasting keenness; wide rounded gullets to minimize the tendency to clog and proper "rake" to facilitate clearing of chips. (This is particularly important with softer plastics having a tendency to shred.)

Nicholson can help you *fit the file to the job* — and then *provide* it, through your mill-supply house. Send us a description of your product, material and finishing problems.

NICHOLSON FILE CO. • PROVIDENCE, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

LET'S GO! U.S.A. · KEEP 'EM FLYING!

● **NICHOLSON AND BLACK DIAMOND Files for Plastics** include a range of cuts and sizes of Flat, Mill (illustrated), Square, Round and Half-round; several types of X. F. Swiss Pattern, including Knife and Pillar; the so-called Button and other special types. The Nicholson guarantee: *Twelve perfect files in every dozen.*

NICHOLSON FILES

FOR EVERY PURPOSE

NICHOLSON U.S.A. MADE IN U.S.A.

RUSH

DUFF-NORTON JACKS

Immediate delivery

for important jobs IN YOUR PLANT!

A FEW OF THE 300 TYPES AND SIZES OF DUFF-NORTON JACKS

The ideal jack for general service. Sturdy, efficient. Sizes 5 to 20 tons.

This "Jack of All Trades" combines straight lifting with chain, hook and foot lifting.

Handy Ball Bearing Jack Screws are made in 38 sizes, 5 to 30 tons capacity.

For pushing or pulling with or without chains or cables.

Right in your neighborhood you'll find a Duff-Norton Distributor with a stock of Lifting Jacks ready for your call. You know how valuable these handy tools are for a multitude of jobs—and from the more than 300 Duff-Norton types and sizes, you can pick the RIGHT ones for your specific applications.

Built in capacities from one to a hundred tons, designed for all sorts of specialized or general-purpose service, Duff-Norton Jacks will handle your heaviest loads smoothly, efficiently, dependably. If you don't have the name of a local DUFF-NORTON Distributor, we'll be glad to furnish it.

GET THIS FREE DATA BOOK!

A brand new illustrated data book on Jacks. Send for your free copy of this useful book TODAY. You should have it for your files!

THE DUFF-NORTON MANUFACTURING COMPANY

PITTSBURGH, PA.

Canadian Plant: Coaticook, Quebec

"The House that Jacks Built"

supply. Designed so that strength and efficiency are combined with minimum weight and ease of handling. Made in a light gray which is easy to see by the operators of shop trucks, hose is stocked in ½ and ¾ inch sizes. Of two-braid construction, can withstand working pressures of from 80 to 125 pounds. Compound of the tube is of oil-resistant rubber, with heat-resisting characteristics. Tube does not flake or clog tools. Yarn reinforcement affords a safety factor of more than 5 to 1 under a working pressure of 125 pounds, and insulation has been developed to assist in flexibility and resistance to kinking. B. F. Goodrich Co., Akron, Ohio.

Multi-Breaker

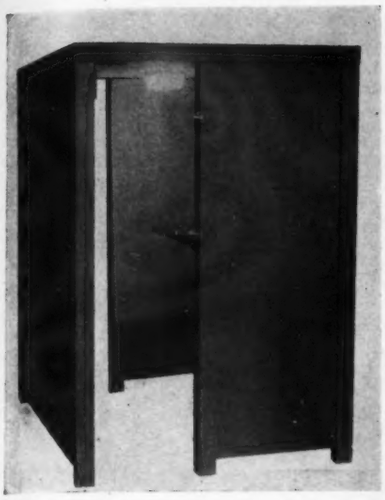
For use on any normal-duty application that would otherwise require fuses or fused switches, multi-breaker is available in two types, M-1 and M-2. These 15 to 100 ampere, 2 or 3 pole breakers are for use on a.c. circuits up to 230 volts. Sheet-steel inclosure is dust-resisting (Nema type 1-A) with 10 concentric knock-outs for conduit or cable connections. In operating, a bimetal thermal element is actuated by overload or short circuit and causes the breaker to trip. However, while the breaker trips immediately on short circuit or dangerous overload, an inverse-time characteristic allows it to remain closed during temporary harmless overloads. An indicating target on the enclosure cover shows when multi-breaker has tripped. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Fluorescent Unit

Fluorescent lighting unit that operates in the same manner as the conventional incandescent unit, it is claimed. Fostoria Canopy—Model MF-240-N is equipped with patented National Transformer "Power Unit" No. 999, approved by Underwriters' Laboratory, accommodates two 40-watt Mazda F lamps, and turns them on and off without starting switches. Standard outside finish is hammered cloud grey enamel baked by the near infra-red process —permanent and "chip proof." Optional finishes are hammered tan and green, wrinkle grey, brown and black, and gloss grey, green, ivory, and white. Standard reflecting surface is baked enamel. Both surfaces are easily cleaned. The Fostoria Pressed Steel Corp., Fostoria, Ohio.

Conference Booth

Conference booth has walls of sound-absorbent construction to soak up factory noise. Designed to meet the need for a large "zone of quiet" for conferences in noisy factories, for use where several telephones may be installed in one location, and for testing operations, such as listening for noise in electric motors. It may even be used as a temporary miniature office in new or remodeled factories where construction is not complete. Doorless entrance at each end permits ready ac-



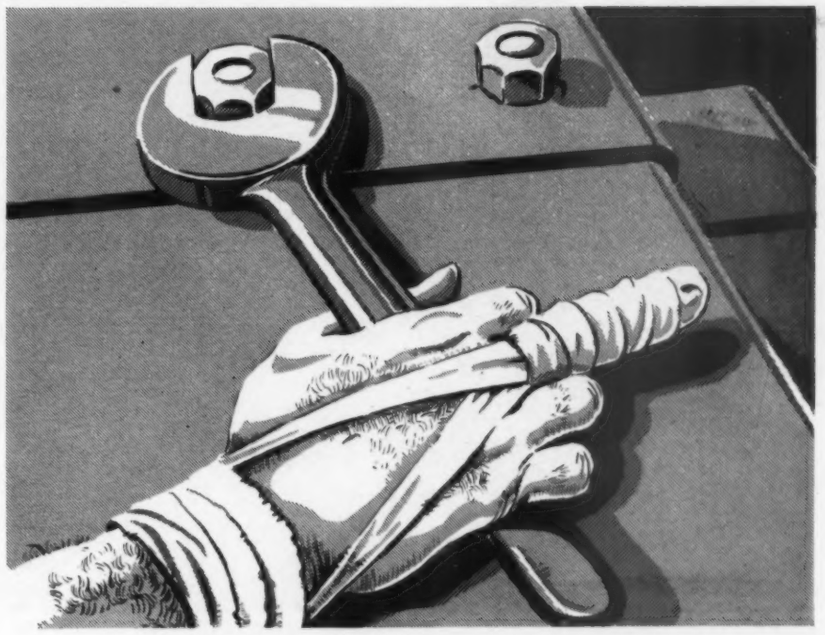
cess to the booth and provides ample natural ventilation. Acoustic construction of the booth makes doors unnecessary. A folding table—23½ x 24 in.—and overhead electric light fixture are included. Easily portable and can be assembled and ready for use in a few minutes. Outside dimensions are 56½ in. long, 54½ in. wide, and 79½ in. high. Shipping weight, 1,000 lb. Burgess Battery Company, Acoustic Division, 530 W. Huron Street, Chicago.

Immersion-Type Booster Heater

Falcon electric immersion-type booster heaters for maintaining and increasing temperatures of a wide range of materials in capacities ranging from 10-kw. to as much as 1,000-kw. output. Consisting of spirally coiled heater strips arranged to form a compact unit, heater is installed in a sealed tank built in the pipe line between storage vessel and coating or saturating tank. Uniform temperature is maintained by automatic controls, either thermostat or pyrometer with thermocouple. Only two connections are necessary for connecting the heater to the electric circuit. Applicable for use with any materials having electrical insulating properties (non-conductors). Furnished in numerous sizes and heat capacities according to customer specifications. H. O. Swoboda, Inc., 134 Thirteenth St., New Brighton, Pa.

Welding Contactor

For use with timing facilities as used in spot welders, electronic welding contactor known as the SW 150 Weld-O-Trol, is rated equivalent to a size 2-W mechanical contactor at 220 or 440 volts, 50/60 cycles. Welding current is handled at extremely high rate of interruption by two heavy-duty water-cooled ignitron tubes. Tubes are held by water-cooled clamps made of copper tubing cast in heat-conducting alloy. Provisions are made for removal of tubes without disturbing the water connections. A thermostat mounted on the cooling clamps protects the tubes against high temperatures caused by failure in the water sup-



Can We Afford to let Dermatitis Slow Down Our Defense Program?

Workers' hands are industry's most important tools — tools that are today speeding up America's defense program. Help protect your workers' hands against skin infection and dermatitis with Formula SBS-11, the safe, industrial skin cleanser. Costs less than 1c a week per worker; removes grease and grime quickly and easily. Write today for generous free trial supply of Formula SBS-11 to Sugar Beet Products Co., 300 Waller Street, Saginaw, Michigan.

Formula SBS-II

THE WASHWORD OF INDUSTRY

Here's Stainless Welding
FOR SEVERE CORROSIVE CONDITIONS

In welding stainless steel, where you want to prevent corrosion and the dangers encountered by carbide precipitation, use this special P&H electrode, proved for the purpose.

"HARSTAIN"—18-8Cb

A stabilized austenitic stainless electrode with base wire sufficiently higher than 18-8 Cb analysis so deposited metal has minimum 18 chrome, 8 nickel, and columbiun 10 times carbon content with a 1 per cent maximum.

This electrode provides the greatest known protection against corrosion in all kinds of welded stainless steel including tanks used in food and chemical plants, oil refineries, paper and other process industries.

HARSTAIN...18-8Cb has an ultimate strength of 85,000 to 90,000 per sq. in. and elongation of 40% to 45% in 2". It is an all-position electrode for reverse polarity. Can also be used on A.C. Available in sizes from 3/32" to ¼". Write for procedures.

P&H WELDING ELECTRODES

General Offices: 4525 W. National Ave., Milwaukee, Wisconsin

HARNISCHFEGER CORPORATION

WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS

ply. All auxiliary control is mounted inside of the Weld-O-Trol steel cabinet door to permit accessibility and yet allow physical separation from the power circuit. Ample space is provided for power and control leads. Unit is readily adapted for use with heat control and either synchronous or non-synchronous weld timers, including sequencing equipment. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Machinery Enamel

Kem enamel, a fast synthetic enamel for machinery, of interest to manufacturers who are either not set up for lacquer work or who need a more resistant finish. Can be applied in 5¾ to 8½ hours, four coats, thus permitting work to be shipped the same day it is finished and assembled. Sherwin-Williams Company, Cleveland.

Smoke Indicator

Model SC-301—indicator-signal type—illuminated density meter continuously indicates smoke density in breeching or stack and provides for an immediate bell and/or light signal when smoke exceeds the maximum allowable density, to warn fireman to take corrective measures necessary. Model SC-302—automatic control of smoke elimination equipment—incorporates all features of Model SC-301, plus full automatic control for magnetic solenoid valve or blower motor supplying steam/air to overfire jets. Adjustable time-delay on load circuit insures correct amount of steam/air to mix with unburned gases and supply oxygen deficiency which is the cause of smoke not burning in the firebox. Rehtron Corp., 2159 Magnolia Ave., Chicago, Ill.

Transmitting System

Differences in temperatures, flows, levels, pressures, can be measured by the New-Matic transmitting system. Consists of two measuring elements equipped with pneumatic transmitters; each delivers an air-pressure proportional to the measured

Doctors Don't Guess

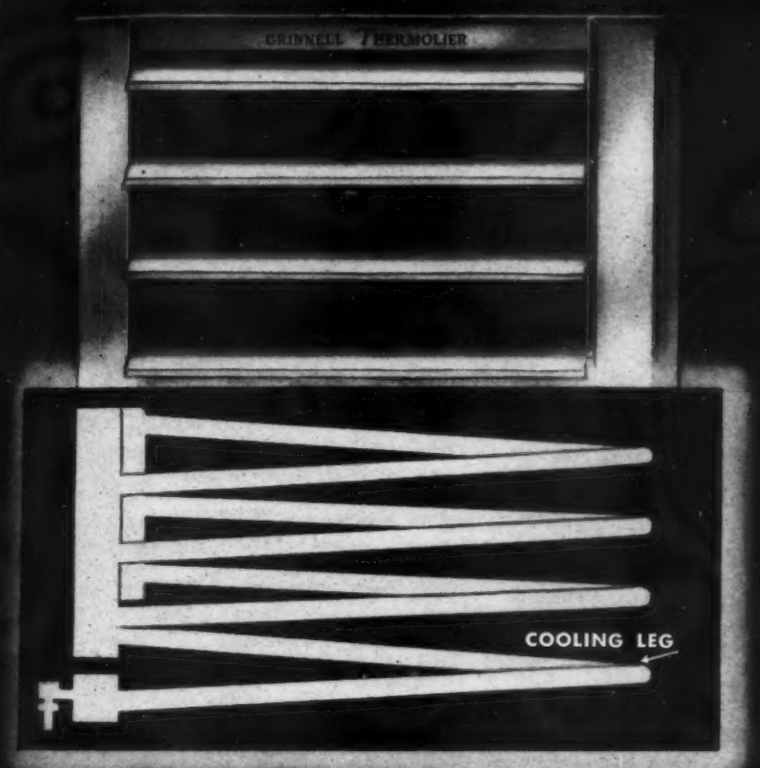
Why Should You?

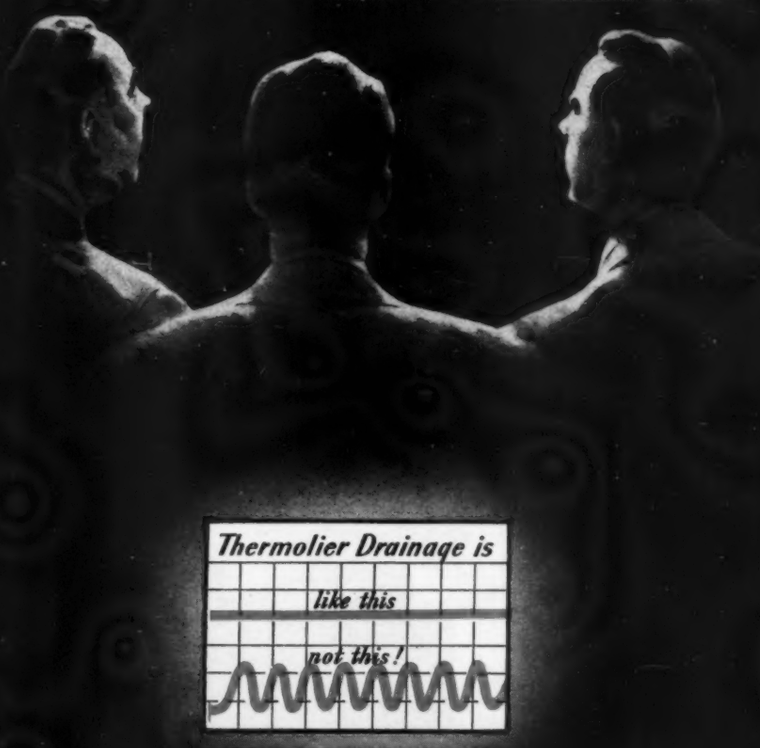
It takes more than a superficial examination to find the strength and weakness of Unit Heaters, too.

You're buying **HEAT** not ornaments, so don't stop at the housings (they're all smartly styled). *Look inside* . . . that's where the differences show up – vital differences in performance under *actual working* conditions, as opposed to standard ratings under ideal conditions.

Outstanding among all Thermolier features is an efficient *Internal* Cooling Leg, integral with the unit. It removes condensate *continuously* instead of intermittently; keeps *all* of the heater working all the time; eliminates "air binding" and hammer; permits use of simple thermostatic trap and is equal in actual cooling effect to *more than 100 feet* of exterior cooling piping.

This one feature *alone* places Thermoliers ahead of all other unit heaters in heating efficiency. Send for complete Data Book explaining Thermolier features. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of the United States and Canada.





OTHER THERMOLIER ADVANTAGES:

1. *U-Shaped Tubes* eliminate expansion strains the simplest way . . . insure dependability.
2. *Positive Built-In Drainage* – every tube is pitched for complete drainage of condensate.
3. *Superior Fin Design* – square fins instead of round – 24% more radiating surface. Patented collars need no solder for strength. Dirt collection is reduced to a minimum.

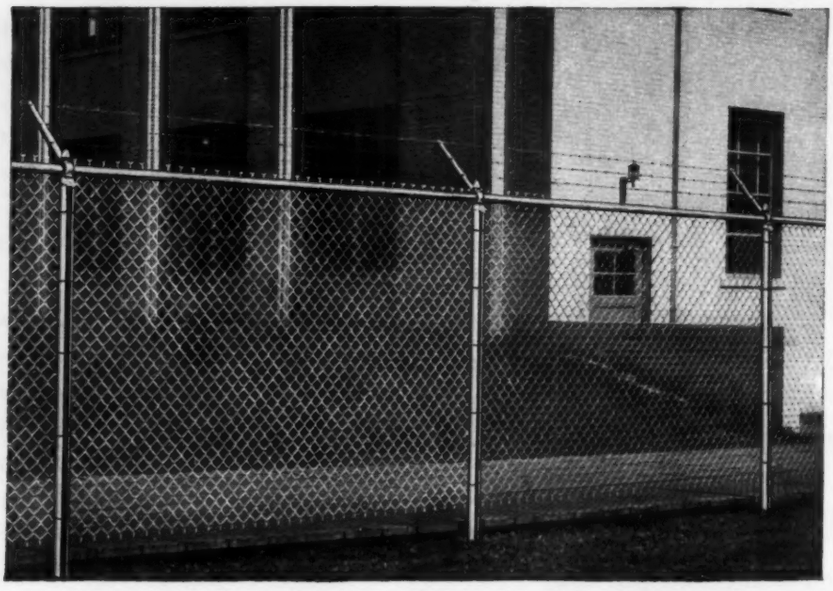
DeLuxe *Industrial* *Factory*

GRINNELL

THERMOLIER

THE UNIT HEATER WITH 14 POINTS OF SUPERIORITY

Government Contract Work
Demands Protection
"Outside and Inside" Your Plant



AN ANCHOR FENCE AROUND YOUR PLANT, PLUS ENCLOSURES INSIDE, GIVES COMPLETE PROTECTION

The moment you secure a Government Defense Contract—your plant and personnel are subject to danger from saboteurs and spies who are intent on destroying or hindering all Defense orders. Perhaps you've already installed a fence—to give you complete protection from outside sabotage agencies. But wartime conditions make it vital to raise similar impenetrable barriers *inside* your plant property—around power stations, transformer installations, chemical storage, fuel supply to make definitely certain that only specially selected employees can reach these and other vulnerable points in your plant. Remember, there may be potential saboteurs on your payroll right now!

Anchor Fences can be Moved in Case of Plant Expansion

An Anchor Fence can be quickly installed, yet can be moved without loss in case of plant expansion. Send for the Anchor Engineer. He'll give you the benefits of Anchor's long experience in fence protection. Show you how to secure complete protection outside and inside your plant with a minimum of expense for guards.

Write now for the Anchor Fence Engineer in your locality. He'll gladly help you plan complete protection. Anchor Post Fence Co., 6620 Eastern Avenue, Baltimore, Maryland.

NATION-WIDE SALES & ERECTING SERVICE

YOUR BEST DEFENSE IS AN ANCHOR FENCE

variable, and a differential pressure detector employing a mercury filled U-tube and a float actuating a recording or indicating pointer.

Where the differences are large, a wide range can be covered. Where the differences are small, minute changes can be easily observed. The Brown Instrument Co., Philadelphia.

Portable Dust Collector

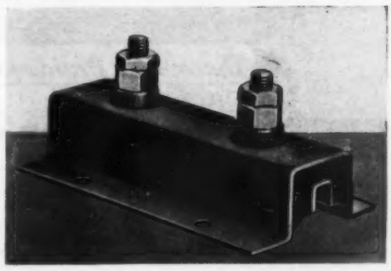
Portable dust collector, weighing 75 lb., is mounted on three legs pivoted at the top, held at the center by chains so that the legs may be folded, and the complete unit carried to any location. Three-quarter inch pipe can be installed in the 1-in. pipe legs, telescoping to give any desired height. Of the centrifugal type, the collector has an air capacity of approximately 200 ft. per min., with a draft loss of 8 in. when operating on atmospheric air at 70 deg. F. and normal pressure. Efficiency varies between 95 and 99 percent. Bowen Research Corporation, Garwood, N. J.

Heater

All-steel, lower-cost version of "Instant" water heater is used to heat water and other liquids with steam. Can be hooked up to high-pressure steam lines without reducing valves. Outer shell is heavy wrought steel pipe. Two concentric smaller pipes are centered within, so that a steam chamber is formed between the outer wall of the smaller pipe and the inner wall of the surrounding pipe. Water is admitted to the central pipe, where it encounters a spiral baffle which creates turbulence and also increases the length of travel in contact with the heated wall. The water then returns back to the outlet through the outer chamber, where another spiral baffle multiplies its length of travel and velocity along the surface of the hot steam chamber. Will withstand steam pressures as high as 150 lb. in standard types—as high as 250 lb. in special heavy-duty types. Cast iron heads easily removable, so heater can be disassembled for inspection or cleaning. Can be used for heating water, various oils, and process liquids, for booster service, pre-heating boiler feed water, and many other applications. Johnson Corp., Three Rivers, Mich.

Rubber Mountings

Several types of isolators employing rubber as a cushioning medium have recently been announced. Of interest to



The "American" Daisy is an unrivalled value among small, all-purpose trucks. Weighs only 30 lbs. This is one model in a complete line of sizes and types for every hand truck requirement.

. . . . says Benjamin Moore & Co. of **AMERICAN** *Pressed-Steel* **HAND TRUCKS**

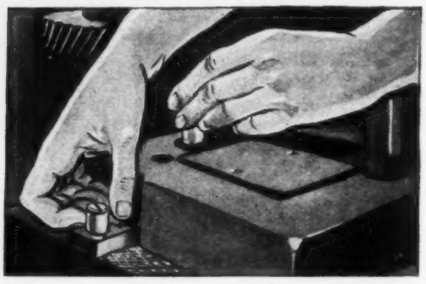
Here's a short, sweet story that will interest every hand truck user. Benjamin Moore & Co., leading paint producer, uses American Pressed-Steel Hand Trucks for innumerable handling purposes, both at the plant and on each of the company's "pick-up and delivery" motor trucks. Service is admittedly tough. But—"Americans" operate so well that Moore employees can handle heavy loads with ease. And maintenance hasn't cost a penny in 6 years!

Amazing performance? Perhaps, but typical of what American pressed-steel construction can do — *will* do for you. Buy "Americans" and say good-bye to maintenance and replacement costs!

THE AMERICAN PULLEY COMPANY
4240 Wissahickon Avenue, Philadelphia, Pa.

AMERICAN
PRESSED-STEEL
HAND TRUCKS

PENNIES *at the Wash Fountain*



for DOLLARS *of Increased Productivity!*

It is *not* a far cry. There *is* a direct relationship—for production DOES depend on the condition of men's hands. They can't do GOOD work — fine work — if harsh soaps have parched the skin and made fingers stiff and leather-like. On many, many jobs they need sensitive feel—and flexible finger grip.

Did you ever watch a workman, just come on shift, stop and stretch and rub his fingers so he could do his job? Did you ever count the half hour that's wasted before his fingers limber up? That's what we mean!

LAN-O-KLEEN a new, corn-meal soap impregnated with lanolin is not only a simple, direct help for such conditions but an efficient ALL PURPOSE hand cleaner for EVERY washroom. It cleans without abrasive pumice, sand or silica —without caustic chemical action. AND the lanolin oil is a natural emollient.

LANOKLEEN* **NEW SKIN-SOFTENING HAND SOAP**

HELPS EFFICIENCY WITHOUT ADDING TO SOAP COST . . . AS INVESTIGATION WILL PROVE.

*Trade Mark Reg. U. S. Pat. Office

CLIP THE COUPON AND LET US DEMONSTRATE

WEST DISINFECTING COMPANY

WEST A GUARANTEED PRODUCT

42-16 WEST ST., LONG ISLAND CITY, N. Y.

Attention Dept. J

I am interested in your FREE TRIAL offer of a Dispenser and sufficient LAN-O-KLEEN to test out for 2 to 3 weeks in one department. Please get in touch.

Name of Individual.....

Name of Company.....

Street and City.....

builders and users of small engines and relatively lightweight machinery. Rubber-in-shear:—Safety mounting with load capacities for individual units ranging from 25 to 450 pounds. Two or more of these mountings may be combined in steel housings when greater load capacities are required. Rubber-in-compression:—Compression type of mounting suitable for concentrated loads. Top and bottom steel sections are securely bonded to the circular rubber stock. Load capacities range up to 1,200 lb. per mounting. May also be used as a shear-mounting by bolting the base plate in a vertical direction.

Mountings also available in extended integral bases.—The Korfund Co., Inc., Long Island City, N. Y.

Lubricating Systems

Progressive lubricating system, centralized to permit high pressure grease lubrication to any number of bearings on a given piece of industrial equipment will deliver from one central point a predetermined quantity of lubricant to from 3 to 20 bearings. When the job is completed a readily visible indicator signals the operator. On equipment that involves a larger number of bearings, Alemite progressive lubricating systems can be employed in relays, each relay lubricating a maximum of 20 bearings. Any type of manually or power-operated high pressure grease gun can be used. An advantage of the system is its simplicity of installation. Designed expressly for large-scale industrial lubrication, it offers four major improvements in this type of lubrication: (1) All bearings in one piece of equipment can be lubricated simultaneously from one central point; (2) inaccessible or dangerously located bearings are conveniently lubricated at will; (3) lubrication of complete machinery is speeded; (4) machines may be lubricated while operating. Alemite Division, Stewart-Warner Corporation, Chicago.

Paint

Maintenance paints for use in factories, hospitals, and institutions, to be known as Johnson's Wax-Fortified Paints are announced. The impregnation of these paints with wax particles produces a finish that is difficult to mar and easy to clean. Line includes: mill white gloss, and flat, commercial interior gloss and flat, transportation enamel, undercoat and primer for Johnson's Wax-Fortified Paint. S. C. Johnson & Son, Inc., Racine, Wis.

Resistors

Negative temperature coefficient resistors of a hard, black, non-metallic substance, the chief characteristic of which is a decrease in electrical resistance with an increase in temperature. For where it is desired to reduce or eliminate initial current surges, to secure a time delay or "gradual building-up" of the current through a piece of equipment, to provide temperature compensation in apparatus or

The New

FA KLAMPSWITCHFUZ SWITCHBOARD

Dead Front—Dependable—Medium Priced

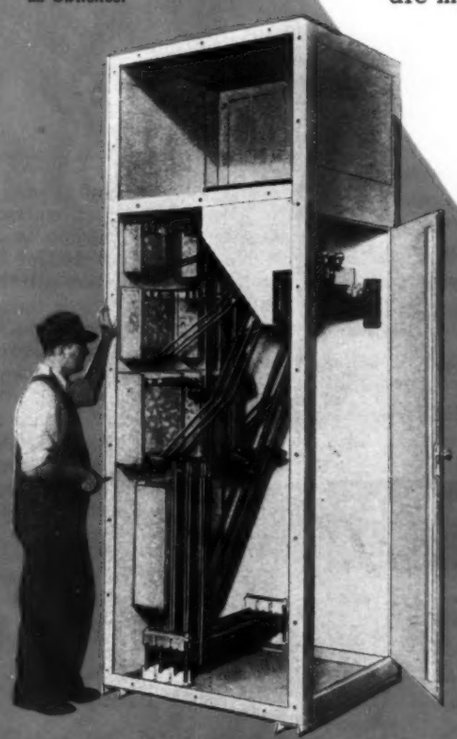
In this new switchboard, exceptional design, quality and satisfactory service are combined with moderate cost. Due to its sectional construction, grouping of switches of any required capacities is possible. Two or more of these units may be placed side by side, if desired, to build up a larger center of distribution.

Front view of FA Klampswitchfuz Switchboard, with 2—60 amp., 2—100 amp., 2—200 amp. and 1—400 amp. Klampswitchfuz Switches.

The following Advantages are incorporated in the FA Klampswitchfuz units which comprise these switchboards:

1. Dead front—covered contacts.
2. Contacts are silver plated, insuring low resistance.
3. Extended feeders—this eliminates tangle of cables in rear.
4. New and improved FA solderless lugs.
5. Clamp type fuse holders—low resistance, minimum heating.
6. Easy to replace fuses—fuses are mounted on door.
7. ON and OFF position indicator.
8. Horsepower rated.
9. Sectional, cubical construction—uniform appearance.
10. Pleasing design—pearl gray lacquer finish—easy to keep clean.
11. Integral pullbox.
12. Easy and economical to install and connect.

Capacities: 30 to 1200 amp., 250 volt DC and AC; 30 to 600 amp., 575 volt AC; in 2, 3 and 4 pole types.



Side and rear view of above, showing integral pullbox and arrangement of copper busbars

In New and Modernized Plants

this, and these other FA Products will serve faithfully and well: Feeder Busduct . . . Plugin Busduct . . . Shutlbrak Safety Switches . . . Power and Light Distribution Panelboards (Standard and Column Types).

FA *Sales-Engineers Can Help You*

Their long experience and training are at your service—without obligation. Write for the name and address of the one nearest you. And ask for complete catalog information . . . Frank Adam Electric Company, St. Louis, Mo.

EST. THE SIGN OF A 1891 BETTER JOB

Frank FA Adam

1891 FIFTY YEARS SERVICE 1941

FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

Now That Aluminum Paint Has Temporarily "Gone With the Wind"

What Are YOU Going To Use To Protect Your Equipment—Tanks—Structures?

Many Maintenance Executives Are Standardizing On

LIGHT GRAY TOTRUST

—The Penetrating, Rust-Preventive Oil Paint

THAT STOPS RUST AT ITS SOURCE AND PREVENTS FURTHER RUSTING!

Showing surface of metal where oil paint has cracked and allowed corrosion to start.

Showing rusted surface of metal with TOTRUST penetrating and sealing rusted particles from further corrosion.

TOTRUST Resembles Aluminum Paint!

TOTRUST Has exceptionally high protective qualities!

TOTRUST Is economical for maintenance use!

TOTRUST Is Also Supplied in White, Gloss Black, Red, Machine Gray, Olive Green and Clear

TOTRUST is not a substitute for aluminum paint—not an "ersatz" makeshift! *TOTRUST is a top-efficiency rust-preventive paint in its own right*—used for years by many of the leading industrial plants in America!

TOTRUST *penetrates* into pinholes and rusted pits in metals—*expels moisture—surrounds* and completely *isolates* rust-particles—and forms a hard, durable film which *remains flexible* through a wide temperature-range!

DAMP METAL—even solid rust—can be *safely* painted with TOTRUST! There is no need of expensive sand-blasting or complete removal of rust, which often costs more than the actual painting job.

Does all this sound too good to be true? Then Mail The Coupon—for the FACTS on TOTRUST!

For Solving Difficult Maintenance Problems Use These Specialized Products:

DYE-CRETE
For *dyeing* and *coating* concrete floors in *one* hour, with color becoming *part of the cement.*

BONDLITE
For all interior walls and ceilings; for *damp* or *new plaster* or *porous surfaces.* Reflects approximately 90% of light; non-yellowing.

EXTERIOR BONDLITE
For *exterior masonry—new* or *old—damp* or *dry.*

DAMPCOAT ENAMEL
For gloss finish on masonry or machinery; particularly where *dampness* is a problem.

STAINCURE
Effectively seals *oil, asphalt, sap* and *other stains.*

THE WILBUR & WILLIAMS CO.
Park Square Building, Boston, Mass.

The Wilbur & Williams Company
Park Square Building, Boston, Mass.

Please send me by return mail, detailed information on LIGHT GRAY TOTRUST for use on (please check)

.....Tanks; .....Structural Steel; .....Machinery; ..... Product Finish.

Name and Title.....

Company .....

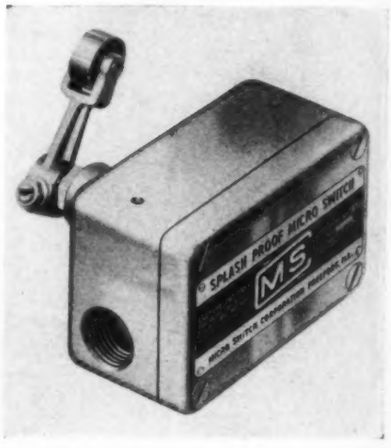
Address .....FM&M, 9-41

equipment which exhibit rising resistance with increase in temperature, and for other applications where a negative temperature coefficient is required.

The temperature of a resistor made of this material can be changed externally by a change in ambient temperature, or internally by heat developed by passage of current through the resistor, or by a combination of both. Change of resistance with temperature change occurs in the region of ordinary temperatures; namely, 0—150 deg. C. Resistors can be produced in a wide range of resistance values, which remain stable for a long time provided they are not excessively overloaded, and can be supplied in a wide variety of sizes and shapes. Connections are "moulded-in" to provide secure and permanent electrical contact. Keystone Carbon Co., 1935 State St., St. Marys, Pa.

Micro-Switch

Splash-proof, malleable housed, precision switch that can be mounted from any one of four sides for use as an interlock, limit, or pushbutton switch, works well where closely held operating points and movement differentials are needed and where any splashing may occur. Variety of mounting positions is a useful feature



of the switch. Two tapped holes for No. 10-32 screws are on each of four sides, making it possible to mount the switch directly to a machine frame from practically any position. If lug or foot mounting is desired, $\frac{7}{16}$ in. thick steel mounting plates can be furnished. Switching element is a Bakelite Micro Switch. Assembly is Underwriters' listed, and the switching element is also listed by Underwriters' at 1,200 watts up to 600 volts a.c. Both types of roller arm are adjustable through 360 degrees with the roller of a non-sparking material of high concentricity. Roller rides on an oilless-bronze bearing. Overtravel is 90 degrees. A removable cover provides easy access to terminals which are well supported on the switch element itself. Conduit measurement is $\frac{1}{2}$ in. Micro Switch Corp., Freeport, Ill.

Power Float and Tamp

Flexrock power float and Flexrock grid tamp are especially designed to produce

New "ABC" Vertical Unit, for ceiling mounting. Floods working areas with warm air. For either steam or hot water systems. Proved practical—rated in accordance with the Standard Test Code of the American Society of Heating and Ventilating Engineers. Write for Bulletin A-9418.

TURN ON THE HEAT

with AMERICAN BLOWER UNIT HEATERS

Fuel conservation for national defense is the order of the day. You'll help Uncle Sam, cut fuel waste, reduce heating costs, prevent cold weather shut-downs and keep production moving by installing American Blower Unit Heaters now! Save up to 33% on fuel! Whether you burn coal, gas or oil for steam or hot water heating, it will pay you to replace your inefficient or obsolete system with American Blower Unit Heaters. Owners who have installed these modern heaters with thermostatic control report savings as great as 33%. Built to top quality standards. Sold on easy terms through our affiliate, The Heating and Plumbing Finance Corporation. Act now! Phone or write our nearest branch (there is one in all principal cities) for data, then get your order in early to avoid delay. It's time to turn on the heat!

Venturafin Unit Heater for many general heating jobs. Famous for its economy. Hundreds of thousands in use. Bulletin A-9318.

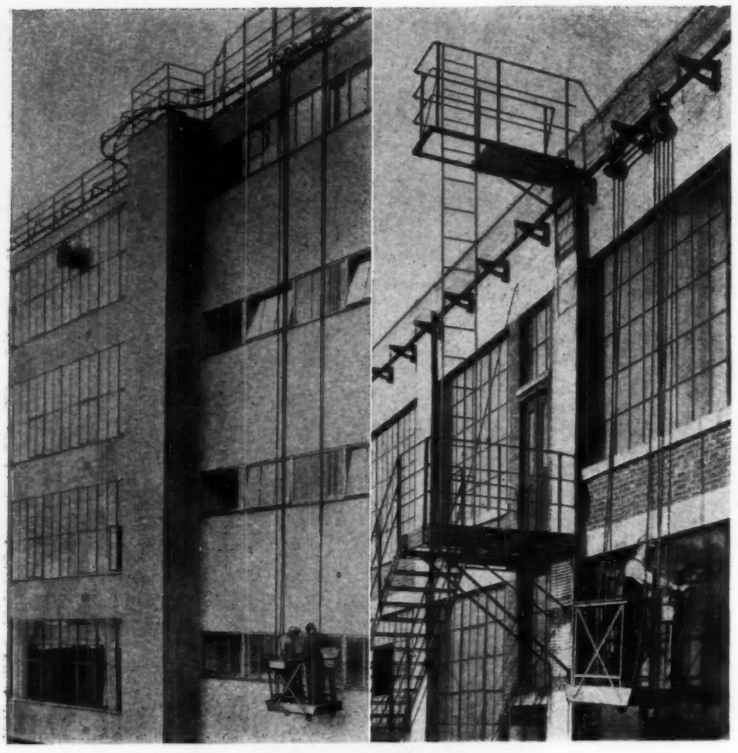
AMERICAN BLOWER

Unit Heaters

AMERICAN BLOWER CORP., 8000 Russell Street, Detroit, Michigan

CANADIAN SIROCCO CO., LTD., Windsor, Ontario

Division of American Radiator and Standard Sanitary Corporation



WASH WINDOWS THREE TIMES FASTER

Window washers are safe in this cage. They can wash more windows faster and easier.

Windows at all levels of a building can be washed faster, safer and at a tremendous savings with Cleveland Tramrail window washing equipment. Costs can be usually reduced to 1/3 for average buildings and to 1/4 for some buildings.

Danger of injury is practically eliminated. The washers work in a guarded cage, which is large enough for two men to work in comfortably.

The cage is suspended from a carrier which operates on a rail attached near the top of the building. It may be propelled to any point and raised or lowered by a chain hoist so that every window may be easily reached. It is equipped with castors so that it may be detached and rolled inside building when not in use.

It will pay you to investigate this modern, safe, cost-saving way of keeping your buildings light and cheery.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1187 Depot Street Wickliffe, Ohio

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT
Other products: CLEVELAND CRANES and STEELWELD MACHINERY

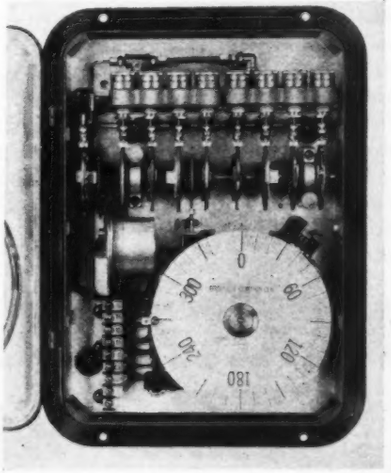
toughness and durability in mastic floors. Drier mixes can be used, less labor is required to resurface large floor areas. Special designing, plus the action of Compactor hammers pounds in the floor closing the voids in the aggregate. Traffic action is transmitted to the foundation by direct contact with the particles of the aggregate. Grid tamp is detachable for easy carrying. Flexrock Company, 23rd & Manning Sts., Philadelphia.

Bulk Conveying System

Bulk-Flo is a power-operated conveyor system for flowable granular, crushed, ground, or pulverized materials of a non-corrosive, non-abrasive nature, in capacities of 1 to 140 tons per hour. System is self-feeding and clearing, needs no separate feeder; operates slowly within a dust-tight casing; moves material gently and quietly; and requires relatively little power for its operation. Bulk-Flow elevating, conveying units can follow almost any desired path—horizontal, inclined, vertical, or curvilinear, and a single self-contained unit may carry in all these directions in the same vertical plane. Can be fed or loaded at various points. Feed and discharge openings, also openings for inspection and access, are readily provided. Loads itself uniformly and gently from hoppers, bins, or chutes, without flooding or overloading. Operates without churning action, at chain speeds of only 10 to 80 ft. per minute. Automatic relief is afforded to the material in passing around curves. A safety release acts quickly in event of jamming from entrance of foreign materials. Link-Belt Company, 307 N. Michigan Ave., Chicago.

Time Cycle Controller

Multiple-cam time cycle controller, known as the Model A-118 impulse-sequence cycle controller, for timing mechanical operations in industrial processes is designed for use on tire molds and other plant processes where a number of factors must be accurately timed according to a fixed program. In operation the controller actuates or engages, at exactly the correct time in each cycle, the necessary mechanical, electrical, or pneumatic de-



Painting's just a matter of dollars and sense

. . . when you can use the best paint at a lower "on-the-wall" cost, it's plain horse sense to do just that. Check up and you'll find that means . . .

BARRELED SUNLIGHT

• For more than 40 years, Barreled Sunlight has been recognized by plant maintenance men as the quality leader in the industrial white-paint field—as the white that means lower "on-the-wall" costs.

But . . . did you know that today Barreled Sunlight costs you *no more per gallon* than ordinary good white paint?

No wonder plant operators the country over report greater savings than ever with Barreled Sunlight whites! And because Barreled Sunlight offers you not one but **THREE** money-saving whites—each the finest available in its price range—you can get just the white you need to meet your plant conditions *and your pocketbook!*

This year, buy your paint this way. Talk to your Barreled Sunlight Representative. Let him inspect your plant. He'll show you which of the three Barreled Sunlight whites is best suited to your purpose. You'll find his recommendations will help you get a finer, whiter, longer lasting paint job for less money!

Send for free booklet—"The Right Paint for Your Plant." U. S. Gutta Percha Paint Co., 2-I Dudley Street, Providence, R. I.

SECRET OF BARRELED SUNLIGHT'S 40 years of leadership is never-ending research. Working with the exclusive Rice Process—*which* (because it defies chemical analysis) *no chemist can copy*—Barreled Sunlight chemists have made Barreled Sunlight whiter and whiter, given it far higher white-retention, greater flowing, hiding and spreading powers. And they've made all these advantages possible at the same price you'd pay for ordinary white paint.

BARRELED SUNLIGHT

SPECIALISTS IN WHITE PAINT FOR INDUSTRY FOR 40 YEARS

• SAVE TIME *with* KIRK & BLUM BLOW PIPE PARTS

Outstanding advantages of KIRK & BLUM Blow Pipe Parts are their rugged construction, adaptability and machine-made accuracy. They enable your maintenance tin shop to get jobs done faster—because they eliminate the necessity of drawing patterns and making every piece before erecting. Changes and repairs can be made with a *minimum loss of time and production.*

Large stocks permit shipments to be made same day orders are received. Write today for details and prices . . . or send us a trial order.

ONE-PIECE ELBOWS

Don't waste time making elbows by hand, when KIRK & BLUM can supply you with elbows that are far superior to, yet cost less than, the hand-made kind. KIRK & BLUM Elbows are made from a single piece of sheet metal, rolled into a cylinder, then ribbed by a special machine. This ribbing process produces an elbow of extraordinary strength, having only a single seam to be soldered. Sizes up to 14″ in diameter.

(Above) Kirk & Blum Ball Joint

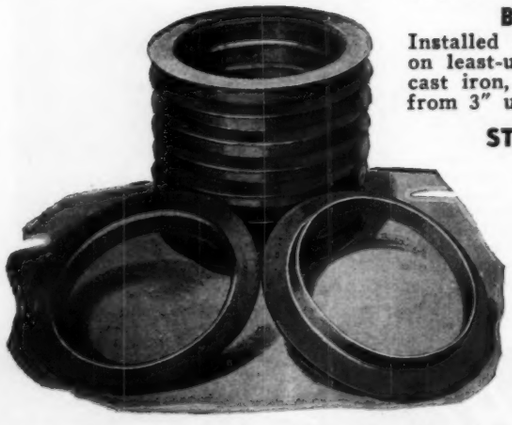
(Right) Kirk & Blum Blast Gates

BALL JOINTS

KIRK & BLUM Ball Joints are made of cast iron, black japanned. Provide flexibility in pipes to moving cutter heads or swinging emery wheels. Sizes from 3″ to 14″, inclusive.

BLAST GATES

Installed to save air and power on least-used machines. Made of cast iron, black japanned. Sizes from 3″ up.



STEEL FLANGES

ROLLED STEEL FLANGES—6″ to 36″
PRESSED STEEL FLANGES—3″, 4″, 5″ Diameter.

Utmost accuracy and strength are assured. Prompt shipments from stock of standard sizes. Special sizes of flanges and angle rings can be furnished promptly.

THE KIRK & BLUM MFG. COMPANY
"Over a Third Century of Service to American Industry"
2835 Spring Grove Avenue • CINCINNATI, OHIO

vices for automatically carrying out the intended schedule. In this control time measurement and pilot valve operation are handled by separate mechanisms. Timing is accomplished by a telechron-driven aluminum disk on which is printed a 25-in. time scale. Desired schedule of operations is incorporated into the controller by punching holes with an ordinary ticket punch on the time scale. The location of these holes determines the time of operation of the cam mechanism. Disks for new cycles or schedules of operation can be easily made. Cams are individually adjustable and their setting does not require fine adjustment in order to get accurate results. Any sequence of operation can be obtained. All controllers are drilled for eight cams and pilot valves. The Bristol Company, Waterbury, Conn.

Stopwatch

Electric stopwatch, known as "Time-it" Minute Model, is run by a synchronous electric motor which operates a direct reading indicating counter. Accuracy is covered by the cycle constancy of 115

volt a.c. current supply. Integrates to 1,000 minutes, reading in full minutes and hundredths of a minute. Can be reset to zero from any reading, or successive readings can be totaled. The Precision Scientific Company, 1750 N. Springfield Ave., Chicago.

Rotary Pump

Pumping unit with gearhead motor drive, will be furnished in capacities from 20 gpm. to 450 gpm. Basic design embodies Blackmer bucket (swinging vane) impeller. Smaller in size. Gearhead motor drive provides a wide range of speed reduction ratios. Two types of bearings are furnished. Conventional sleeve bearings, which permit operating pressures up to 100 psi. with lubricating liquids, and 50 psi. with non-lubricating liquids; and anti-friction roller bearings which permit pressures of 150 psi. with lubricating liquids and 125 psi. with non-lubricating liquids. Pumps for higher pressures, adaptable to certain hydraulic machinery, also available. Blackmer Pump Co., Grand Rapids, Mich.

Intercommunication System

Super-power electric paging and intercommunicaing system for factories, offices, known as Convers-O-Call model No. 400, allows conversation between 1 to 10 people at one time or individually. Calls can originate from either end. Two-way

A.G.M.A. moves to assist National Defense

You can help

Facing today's problems, every Defense buyer wants to save time in buying and get deliveries as quickly as possible. Recognizing this urgent need, individual members of the American Gear Manufacturers Association are concentrating gearmotor production on the recommended standard speed combinations as adopted by AGMA and approved by the National Electrical Manufacturers Association, as shown in the paneled list to the right. Adopting these speeds as YOUR standards will expedite shipments, save valuable time in buying, and get results faster.

American Gear Manufacturers Assn.
Shields Building
Wilkinsburg, Pa.

AGMA
AMERICAN GEAR MANUFACTURERS ASSOCIATION

★

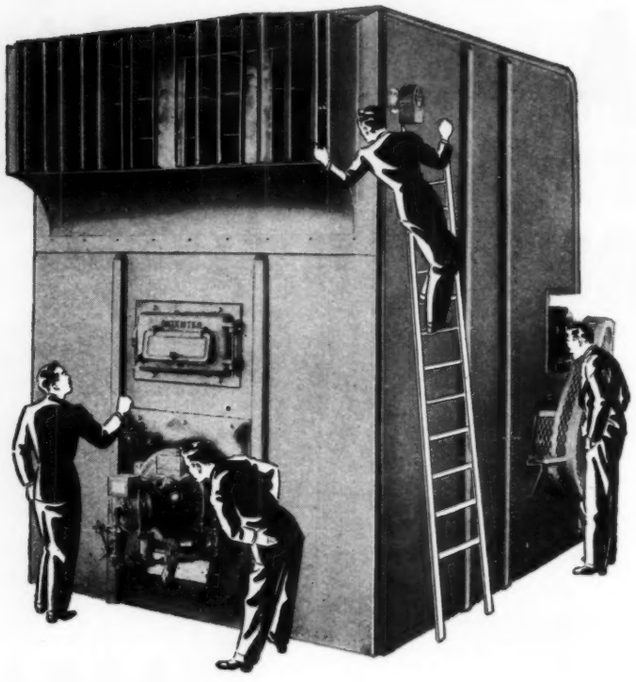
A.G.M.A. STANDARD OUTPUT SPEEDS

STANDARD OUTPUT SPEEDS for concentric and parallel shaft integral hp Gearmotors. Based on 1750, 1430 or 1165 rpm motor operating speeds.

1430	190	25
1170	155	20
950	125	16.5
780	100	13.5
640	84	11.0
520	68	9.0
420	56	7.5
350	45	6.0
280	37	5.0
230	30	4.0

AGMA

The closer you look
The better you'll like it:



DIRECTHERM
HEATER

the direct-fired Unit Heater in 6 sizes (300,000 - 1,700,000 BTU) for plant, office, and shop.

It is a real fuel saver. Whether you burn oil, gas, or coal—it produces about 80% of the invested fuel energy and distributes it evenly up to 200 feet distance. That's heating efficiency!

The Directherm Heater is built to keep your cost down. The first cost is low, the installation simple, and the up-keep negligible, due to the sturdy construction.

Start your saving program today by writing for our bulletin 305 Z. It tells you the whole story.

AIRTHERM
MANUFACTURING COMPANY

704 S. SPRING AVE. ST. LOUIS, MO.

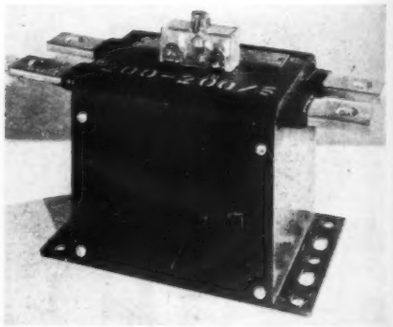
voice-link at any distance up to about 3 miles. Uses less current than a 40-watt bulb, operates on 110-125 volt a.c.-d.c. current from a single electrical outlet. A flip of the finger carries voice instantly to distant parts, and employees can answer instantly 50 to 100 feet away from their substation unit without leaving their work. Can also be used as a "public address" or "paging system." National Inter-Communicating Systems, 2434 Montrose Ave., Chicago.

Insulation Resistance Tester

Model B-5 Megohmer simplifies insulation testing. Works on principles that make it possible to do away with hand-cranking of a generator. Specifically developed for practical plant maintenance men, to stand rough usage under general conditions. Covers a range of 0-200 megohms for insulation tests, 0-2,000 ohms for low-resistance measurements, and, in addition, has two d.c. voltmeter scales 0-300 and 0-600 volts. Is self-contained, built in a rugged case, has a steady test voltage of 500 volts d.c., a sensitive movement, mirror scale, knife-edged pointer, and a triple color grading scale feature, which classifies insulation as good, fair, and doubtful, and eliminates any doubt of the non-technical user about the interpretation of the readings obtained. Five recessed, widely spaced binding posts and an instruction plate, permanently mounted in front of the operator avoid any possible confusion in operating this instrument. Herman H. Sticht Company, Inc., 27 Park Place, New York City.

Indoor Current Transformer

Designed for three-wire metering applications demanding high accuracy, dry type indoor current transformers are made in 18 ratings, covering a range from 5 to



500 primary amperes on lines up to 1,200 volts. Designated as type TW, they have practically flat ratio and phase angle curves from 15 to 200 percent current, resulting in high metering accuracy over a wide range of loads. Unaffected by unbalanced loads, performance is the same under zero or maximum unbalance in the three-wire circuit. Constructed in a ¼-inch duck Micarta case, unit is strong enough to withstand unusually rough handling and will not warp from effects of heat or aging. Secondary short-circuiting switch is mounted on top of the transformer inside

Save precious seconds in production with

DISSTON

SAWS and FILES

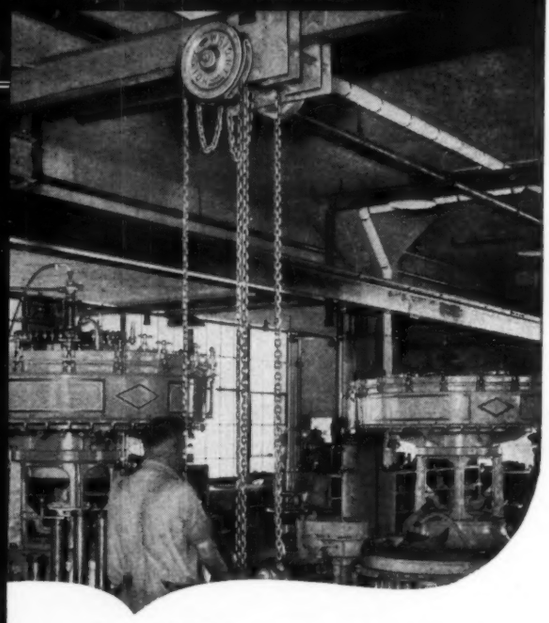
You can speed up hand or machine cutting of metals by using Disston Hack Saw Blades . . . proved faster and more durable in actual shop tests. Use Disston Di-Mol Hack Saw Blades for general work; they keep their keen edge when other blades break teeth and fail. For cutting stainless steel and other tough alloy steels, you'll save a lot of time by standardizing on Disston High Speed Steel Hack Saw Blades.

When you want added speed and precision use Disston Hard Edge, Flexible Back, Metal Cutting Band Saws. They, and Disston Metal Cutting Circular Saws, are "tops" for cutting fast and clean through a wide range of ferrous and non-ferrous metals.

Gain additional seconds in metal finishing operations by using Disston Bite-Rite Files. They take off more metal with each stroke, leveling and smoothing as they cut . . . filing faster and more evenly.

Disston Engineering Service is yours for the asking . . . a simple way to get the utmost from your saws, files and other tools. Write for details to Henry Disston & Sons, Inc., Philadelphia, Pa., U.S.A.

THE WRIGHT WAY TO SPEED PRODUCTION



WRIGHT *Improved High Speed* **HOISTS**
1/4 TO 50 TONS

● *FASTER, ever faster* production is demanded of American industry. One tool that will help speed up your production is the Wright Improved High Speed Hoist.

Wright Hoists are engineered for *fast,* high speed work. Their action is smooth and positive—because of their correct load wheel and driving spindle bearings. They are also *safe* and *economical.*

Ruggedly constructed on precision design, Wright Hoists give you long-time trouble-free service.

As with all ACCO products, safety is an in-built feature. The load chain has a safety factor of 7 to 1. It is made of a special process steel which permits the chain to elongate (under overload) 3″ to the foot before breaking. This same visual factor of safety is inherent in the bottom hook which will slowly open to indicate overload beyond the elastic limit of the chain.

WRIGHT TROLLEYS are made to give the same *fast, economical, safe* service as WRIGHT HOISTS.

WRIGHT MANUFACTURING DIVISION
YORK, PENNSYLVANIA

ACCO

AMERICAN CHAIN & CABLE COMPANY, Inc.
In Business for Your Safety

a transparent plastic cover. All type TW transformers have identical bases, primary terminals and over-all dimensions, so that any unit may be interchanged with another of a different rating. Westinghouse Elec. & Mfg. Co., Sharon, Pa.

Floodlight

Floodlight for use at guard fences around munitions plants and other strategic industrial areas. Weather-tight unit contains an aluminum reflector and fresnel lens to produce an intense beam covering approximately 10 degrees vertically and 180 degrees horizontally. Available for 300-watt standard clear lamps or for series operation with street lighting lamps. Units are mounted at a height of 15 feet on poles, spaced 150 feet apart, set behind the guard fence. The beam is directed to clear the top of the fence with the beam center tilted 5 degrees from horizontal. Anti-sabotage floodlighting makes an intruder clearly visible from the patrol road at a distance of 500 feet. Since only spill light strikes the fence, the more brightly lighted area beyond is not screened. Intruder sees only an impenetrable glare from any angle. Revere Electric Mfg. Co., Chicago.

Magnetic Separator

Magnetic separator, PQ-4 FerroFilter, to remove fine iron and steel particles from circulating lubricating oil systems, is essentially of the same design as the smaller models, but has a capacity of 40 gpm, with a pipe connection size of 1½ inches. S. G. Frantz Co., Inc., 161 Grand St., New York.

Blowers

The Herman Nelson Corporation, Moline, Ill., announces that it purchased on July 1 the entire assets and business of the Autovent Fan and Blower Company, Chicago, Ill. The business will be operated as the Autovent Fan and Blower Division of the Herman Nelson Corporation. The complete line of Autovent products will continue to be manufactured in the Autovent Division in Chicago. Included in the Autovent line are a complete range of sizes of centrifugal blowers from 6 in. in diameter to 72 in. in diameter in both forwardly and backwardly curved blade designs and a complete selection of propeller exhaust and ventilating fans from 12 in. in diameter to 72 in. in diameter. The Herman Nelson Corp., Moline, Ill.

Switch

Precision snap-action switch, adapted for a wide variety of uses. Requires a minimum of change in operating pressure to produce a direct and positive make and break. Acrosnap design offers adaptability to unusual as well as standard uses. Can be adapted to special shapes, sizes, and positions, or built into almost any style mechanism. Single pole, furnished with normally open, normally

closed, or double throw contact arrangements. Standard model, 10 amps. 115 volts a.c., 5 amps. 250 volts a.c., 3 amps. 450 volts a.c., low movement differential; pressure, ½ to 14 oz.; weight, less than 1 oz.; size, 1 15/16 x 11/16 x 27/32 in. Acro Electric Co., 3152 Fulton Rd., Cleveland.

Toggle Type Barrel Dumping Harness

Quick-locking harness to speed up efficient handling and dumping of barrels and drums. Standard barrel hoop truck deposits the drum directly into the harness, thus the drum does not have to be placed on the floor first. Harness is equipped with a spring toggle, is arc-welded throughout, and can be made for any size of drum. Lewis-Shepard Sales Corp., 245 Walnut Street, Watertown, Mass.

Portable Acetylene Generator

Portable acetylene generator for use in oxy-acetylene welding and cutting known as the Oxweld MP-10, will deliver 30 cu.ft. of acetylene per hour, is suitable

for welding metal up to ⅜ in. thick, and for cutting steel up to 5 in. thick. Construction features include two relief valves that automatically vent any excessive pressures, and a hydraulic back-pressure valve that, by providing a water seal between the hose and generator, prevents any reverse flow of gas. Carbide hopper, holding 15 lb. of 14 ND Union Carbide, is designed for easy recharging. Weighs 100 lb. when empty and 250 lb. when charged, and measures 3 ft. 2½ in. in height. The Linde Air Products Company, unit of Union Carbide and Carbon Corp., 30 East 42nd St., New York, N. Y.

Journal Bearings

Line of solid and split journal bearings of accurate dimensions with rounded lines and smooth gun-metal finish, have machined bases and faced ends. Height to center line of shaft is rigidly maintained. The babbitted bores are broached to

GRAPHITE . . .

a truly HEAT-PROOF

LUBRICANT

Retains its lubricity . . .

Remains unchanged in highest operating temperatures . . .

Unaffected by pressure . . . solvents . . . moisture . . .

Dixon's Ticonderoga Flake Lubricating Graphite lubricates long after plain lubricants break down or squeeze out.

Alone or mixed with oils and greases, graphite impregnates wearing surfaces with a thin, durable lubricating film that prevents costly damage.

DIXON'S TICONDEROGA FLAKE LUBRICATING GRAPHITE

Particle Size No. 1—large, lubricious flakes.
Particle Size No. 2—finely subdivided, powdered flakes.

DIXON'S NO. 635

Minutely subdivided particle size for close tolerance applications.

DIXON'S MICROFYNE POWDERED GRAPHITE

Microscopically subdivided particle size for mixing with oils and greases. Also for dry lubrication of locks, small tools, etc., through handy Dixon's Graph-Air Guns. Can't drip, gum, or collect dust.

A DIXON man can tell you—quickly and surely—WHERE and HOW Dixon Graphites can cut lubrication costs in YOUR PLANT. Write Dept. No. C-44.

DIXON'S SOLID BELT DRESSING

Saves time and labor in proper maintenance of leather, rubber and composition belts. Reduces belt slip, lengthens belt life. No need to shut down for application. Contains no graphite.

GRAPHITE EXCELLENCE SINCE 1827

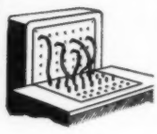
JOSEPH DIXON CRUCIBLE CO.
Jersey City, New Jersey

THEY'V[illegible]TCHED TO THE AMERICAN

Plus!

You, too, can cut assembly time and costs up to 50% by switching to American PLUS Phillips Screws

"After considerable experimentation to find the proper type screw, we selected American PLUS Phillips Screws. They most adequately fulfill our requirements for both quality and manufacturing economy."
—Hygrade Sylvania Corp.



ALL TYPES OF EQUIPMENT ASSEMBLED FASTER . . . MORE SECURELY

Most everybody knows American PLUS Phillips Screws are widely used on automobiles and aircraft. Illustrated are a few of hundreds of products whose manufacturers say fast-driving, non-slipping, tight-seating American PLUS Phillips Screws save 50% in assembly cost. Send for free folders listed below.*

Genuine Phillips recess . . . The PLUS on the Screw Means Less Cost to You

Write "American PLUS" in front of "Phillips" on your orders and benefit from

1. engineering service based on the longest and broadest experience with Phillips
2. piece inspection insuring full quality, full count
3. prompt shipment from largest stocks.

There is an American PLUS Phillips Distributor in Your Vicinity

AMERICAN SCREW COMPANY

Chicago, Ill. 589 E. Illinois St. | Providence, R. I. | Detroit, Mich. 1847 W. Bethune St.

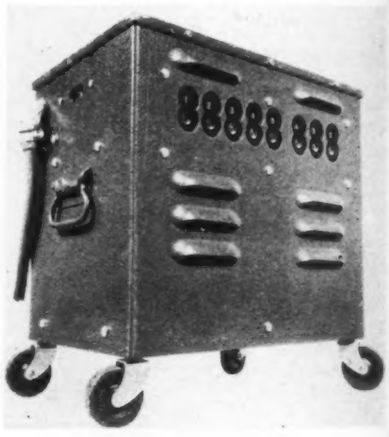
*WOOD SCREWS *MACHINE SCREWS *SHEET METAL SCREWS *STOVE BOLTS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

smooth hard surface and require no "wearing in." Both styles are tapped for grease cups or pressure fittings. Ample storage groove in the top provides proper distribution of lubricant. Split bearing has feeder grooves on each side. Individual containers are furnished for easy handling and protection in shipping. The Jeffrey Manufacturing Company, Columbus, Ohio.

Midget Welder

For use in welding light gage metal, castings, and drive shafts, general maintenance, and light production work, Flexarc welder, known as the Midget Marvel WT-1, comes complete with all accessories, even to the primary cable for hooking up the power line. Included in the accessories are electrode lead and holder, work lead, helmet, and a supply of electrodes. Sensitive adjustment of the welding current over a range from 20 to 140



amps. is provided by 15 steps with correctly proportioned increments between steps. Full-load rating is 110 amps., 30 minutes, 30 load volts, when used on 220-volt, 60-cycle lines. Approximate dimensions of unit are 14½ by 12⅛ by 20 inches long. Weighs 160 lbs., supported on castors to facilitate mobility. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Water Heaters

HG Taco heaters are horizontal gravity water heaters for use with storage tanks from 700 to 3,000 gallons capacity. Heavy gage steel shells and bronze heads. HG shell tappings can be located to meet particular requirements of job. Adaptable for small space. Taco Heaters, Inc., 342 Madison Ave., New York.

Deodorant

Oakite Deodorant No. 1, a triple-action material combining deodorizing, detergent, and disinfecting properties designed to afford means of carrying out sanitation routines in one operation. A dry, white, free-flowing powder, used in cold water, this material is reported to be designed solely for use in connection with deodorizing and cleaning washrooms, shower stalls, first aid rooms, lavatories,

TRADE **AUTOMATIC** MARK

MANUFACTURERS FOR OVER 30 YEARS

Electric Propelled INDUSTRIAL TRUCKS

Fig. 10537-39. Heavy-duty Telescopic Fork Trucks stacking 10,000-lb. bundles steel plate after transporting from receiving. Lower view shows same truck servicing one of many Die-presses with steel plates. Note how truck places load at convenient height to operator.

Fig. 10562. Operator withdrawing Special Skid Racks loaded with Crankshafts from Heat Treat Ovens. These are transported to storage and box-cars for shipment to assembly plants. Fork Truck illustrated is available in 3,000- to 7,000-lb. capacities.

Fig. 10541. One of the many efficient production jobs performed by "AUTOMATIC" 10,000-lb. High Lift Trucks. Truck illustrated facilitates general transportation and placing of Bundled Steel Plate at Presses.

Fig. 10544. Outside storage of engine blocks on pallets in unit loads with "AUTOMATIC" Fork Trucks provides an economical handling system with highest efficiency for Inventory and Production Control.

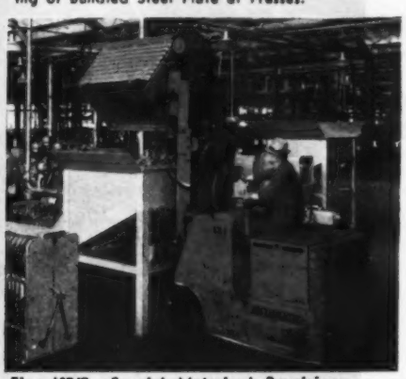


Fig. 10547. Special Motorized Revolving Fork Attachment built integral with Telescopic Fork Truck Lift provides efficient system for charging hoppers as shown with miscellaneous small parts as required for Water and Oil Pump Assemblies — also Valve Guides, Connecting Rods, etc.

MODERN PRODUCTION TOOLS CONTRIBUTING IMPORTANT ECONOMIES TO MODERN BUSINESS

• The "Electric Propelled" Fork Trucks, Die Handlers and Lift Trucks illustrated here are typical of the complete range of "AUTOMATICS" Time Proven Production Tools. These are offered to the Automotive and Aircraft and Metal Industry to facilitate improved handling methods and modern low-cost co-ordinated handling systems regardless of load 2,000 or 30,000 lbs.

Hundreds of these "AUTOMATICS" shown here are today operating in many modern plants in United States, Canada and Foreign Countries. They are vital factors twenty-four hours, day in, day out, contributing successful, dependable, economical, profitable materials handling, transportation and stacking. Each of these "AUTOMATICS" reflect the ultimate in Modern Design — Sturdy Construction — Greater Capacity Facilities — Increased Efficiency—Dependable Performance—Flexibility with Precision and Safety.

REQUEST DETAILS AND LITERATURE

Perhaps one of these "AUTOMATICS" shown is just the type you need right now! Write or 'phone today for full details and prices without obligation.

AUTOMATIC TRANSPORTATION COMPANY

Div. of the Yale & Towne Mfg. Co.

39 W. 87th Street — Chicago, Illinois

Listed Under Reexamination Service of UNDERWRITERS' LABORATORIES

Fig. 10554. One of the many production tasks performed by "AUTOMATIC" Fork Trucks is unloading unit loads of radiators from box-cars and transporting to storage and assembly.

Fig. 10559. Unit load of steel plate blanks formed for rear axles being placed in production storage by "AUTOMATIC" Center-Control Fork Trucks. Capacities 3,000 to 7,000 lbs.

Fig. 10536. Heavy-duty "AUTOMATIC" Die-handler, 20,000 lbs. capacity. Fully equipped with latest motorized Die Loading and Unloading Platform to facilitate accurate Die Placing and efficient transportation to and from storage.

WHEN YOU BUY TRUCKS · · *Buy* "AUTOMATIC"

●INEXPENSIVE INSURANCE AGAINST HEALTH HAZARDS

SLY DUST CONTROL Helps Maintain Quality

Used for ventilating grinders at the plant of the National Sewing Machine Co., Belvidere, Ill., this Sly Dust Control System exhausts dust-laden air from the plant, filters it and returns it to the plant, improving working conditions and helping maintain National's standard of quality.

The exclusive advantages offered by Sly Filters are: (1) *Greater filtering capacity* because of more filtering cloth. (2) *Taut bags* at all times saving power and resulting in quicker removal of dust. (3) *Bags* more easily *replaced*. (4) *Automatic control* (any degree) minimizing or removing the human factor. (5) *Simpler shaker mechanism* resulting in savings in maintenance and operation.

Hundreds of companies have found that Sly Dust Control soon pays its cost by improved efficiency of workmen, savings in wear and tear on machinery, and improved quality of products. Write us fully so that we can tell you just what can be accomplished in your case.

THE W. W. SLY MFG. CO.

Branch Offices in Principal Cities

4755 Train Ave. Cleveland, O.

SLY
INDUSTRIAL DUST CONTROL

and locker rooms. Odorless itself, material dissipates and neutralizes odors without masking or "covering up" one odor with another, and provides dirt and grime removal action on cement, tile, and porcelain surfaces. Its disinfecting properties are said to help provide added protection against harmful organisms. Oakite Products, Inc., 14A Thames Street, New York.

Multi-Breaker

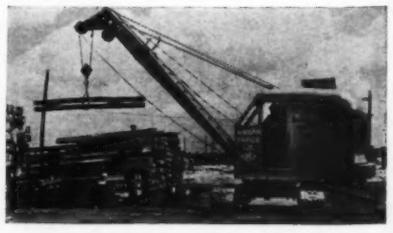
Breaker affords economical application as a motor circuit switch or service disconnect switch. Fuseless, with bimetallic strip actuation, visible trip indication, and trip free lever. Quick make and quick break, with a rated capacity of 23 volts from 15 to 100 amps. available in 3 pole, 3 pole solid neutral or 4 pole solid neutral types. Calibration is set at the factory and cannot be tampered with. The breaker is completely inclosed and semi-dust tight. Front access and operation make this breaker convenient, compact and economical of space. Cutler-Hammer, Inc., Milwaukee, Wis.

Fluorescent Power Unit

National 999 power unit in fluorescent fixtures provides instantaneous light when switched on, at lower temperatures and low line voltages, overcoming the usual waiting period for illumination. Unit eliminates the need for starters, starter switches, starter sockets, and compensator. Operating on a patented, self-polarized, double-circuit principle, unit provides full brilliance, reduces stroboscopic effect to a minimum, operates quietly, has no radio interference, and its power factor is corrected above 90 percent. Easily installed, and so constructed that under no conditions can it overheat or be seriously damaged by overloading, when connected to a circuit of the specified voltage and frequency. National Transformer Corp., 224-232 Twenty-first Ave., Paterson, N. J.

Crane Boom

Yard crane with a short gooseneck boom provides for car loading and unloading, and working in close quarters. Gooseneck on the end of the boom provides handling of lengthy objects in confined space despite the short boom. Material can be stacked 20 ft. high or more with ease. All operations in the work cycle of the crane are



controlled by vacuum power. Six small handles on a "desk type" control board are tilted to perform various operations. Features of the Clipper gooseneck crane include: 175 ft. per minute maximum hoist

THEY WERE TELLING ME HOW TO RUN MY BUSINESS

... AND THEY WERE RIGHT ABOUT ASSEMBLY DELAYS!

REPORTS BLINDED ME —

Our assembly line had to be twice as *fast!* Experts said: "Phillips Screws will cut fastening time in half." But how could *I* afford Phillips?

I TOOK OFF MY COAT

Went down to our assembly line . . . watched our screw-driving operations. Fumbled screws, slipping drivers, scarred work, slow hand-driving — were wasting time *and money!*

OLD-FASHIONED FASTENING?

Yes, slotted screws were costing me money through slow, wasteful screw-driving. And *I* had thought slotted screws cost less because their *price* is less — and I was wrong!

MY ANSWER ... PHILLIPS

So I began to buy Phillips Screws . . . the screws with the tapered recess that *clings* to the tapered driver and prevents driver slippage. They cut our assembly time 50% and went a long way toward solving our delivery-date problem. We now —

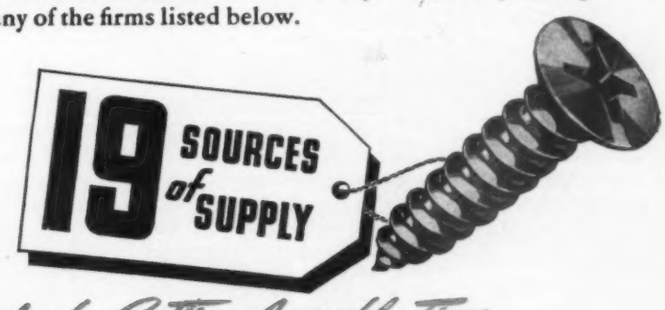
start *fast* with one hand
drive *fast* with power drivers
drive *fast* in awkward positions
keep going *fast* without slipping
seat screws *fast* and tight.

PHILLIPS SCREWS MAY CUT YOUR ASSEMBLY TIME 50%

Look out for wasteful, slow-driving slotted screws — which, though they cost a few cents less than Phillips Screws, are much more costly in the long run. For further information on how *your* industry can speed product deliveries with Phillips Screws, write to any of the firms listed below.

PHILLIPS

RECESSED HEAD SCREWS



Speed Product Deliveries by Cutting Assembly Time

WOOD SCREWS · MACHINE SCREWS · SHEET METAL SCREWS · STOVE BOLTS · SPECIAL THREAD-CUTTING SCREWS · SCREWS WITH LOCK WASHERS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

Diagram: Piston Ring Forming Machine.

Problem: Inadequate lubrication and varying coefficient of friction (Fc) in Guide A and on Forming Head D resulted in unequal ring lengths due to jerky feed through Rolls RR.

Solution: "We have found that with ordinary lubrication irregular slippage occurs in the feed rolls, but with the use of "Oildag" this slippage is practically eliminated and gap accuracy can be maintained", says a prominent piston ring manufacturer.

Other tough problems such as the lubrication of forging dies, bearings operating at high temperatures, etc. can be solved by your oil supplier with lubricants containing "dag" colloidal graphite. Write for Bulletin 130 V

ACHESON COLLOIDS CORPORATION
PORT HURON - - - - - MICHIGAN

dag REG. U.S. PAT. OFF. COLLOIDAL PRODUCTS

"Oildag" and "dag" are registered trade-marks of the Acheson Colloids Corporation

Here are a few of the many uses of colloidal graphite in industry—check any with which you may be having lubrication difficulties.

"DAG" COLLOIDAL GRAPHITE FOR:

CONVEYORS..... ☐	SCREW THREADS..... ☐
FORGING DIES..... ☐	STEAM CYLINDER..... ☐
COMPRESSORS..... ☐	CASTING..... ☐
GLASS MOLD..... ☐	CONDUCTIVE COATINGS.... ☐
ASSEMBLY AND RUN-IN.... ☐	IMPREGNATION..... ☐

Tear off this coupon and attach to your letterhead—it will bring a working sample for the uses you specify.

ACHESON COLLOIDS CORPORATION • Port Huron, Michigan

speed; welded steel box type boom; safety power drum brakes; minimum of 5.25 rpm. full swing; quick convertibility to shovel, dragline, or lifting magnet; travels, swings and hoists simultaneously; 4 anti-friction bearing hook rollers; 43 anti-friction bearings; power boom hoist and safety brake; flame hardened gears; "no chain" power hook-up through gears and double universal joint. Three models available—Model 50, 5-tons, Model 60, 6½ tons and Model 70, 7-tons capacity. Buckeye Traction Ditcher Co., Findlay, Ohio.

Crater Eliminator

Stroco crater eliminator is an auxiliary device that is mounted on the body of the arc welding generator, connected in series with the excitation field of the generator and controlled by a switch which enables the operator to cut it in and out of the excitation field circuit at will. Functions as a variable resistance of large enough capacity to build up the resistance in the excitation field and thus lower the field strength, thereby making it possible to reduce the current density gradually without disturbing the current setting of the welding generator. Control is by a three-position button switch located on the electrode holder. Has found useful application in welding thin walled tubing used for aircraft structures. Wilson Welder & Metals Co., 60 E. 42nd St., New York.

Mobile Tool Cabinet

Mobile tool cabinet built on the principle of the "add-a-shelf" bookcase. Consists of roller cabinet, on top of which may be mounted the master toolchest. Assembly permits moving the complete tool set from job to job, or removal of either the upper or lower toolchest complete for use on outside jobs. Large enough to carry a tote tray, has lock and key and door that slides out of the way. Plomb Tool Co., Los Angeles, Calif.

Electric Silver Solder - Brazing Unit

Electric brazer for brazing and soldering with silver solder operates on the same principle as "Thermo-Grip" soft soldering tools. Consists of a power unit or transformer and a pair of electric heating pliers. Holding the part to be brazed in the pliers closes the secondary circuit, causing the part to quickly heat to brazing temperature. Heat is accurately controlled by on-off foot switch. Compartments provided for heating pliers, foot switch, silver solder, and flux. When not in use all parts can be inclosed and out of the way in readily portable cabinet. Overall size 14 x 12 x 25 in. Weight, 100 lb. (60 cycle unit), 150 lb. (25 cycles). Operates on 230 volt, 50-60 cycle power supply; 440 volt and 25 cycle units also are available. Rating is 7½ kva. Secondary voltage is reduced to 10 volts. Heating pliers have 6¼ in. long throat. Face of carbon is 1¾ in. x 2 in. but may be filed to shape best suited for a particular job. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore, Ill.

It's 9 to 1 you'll be "in a hole" too, IF you don't look to your Electrical Wiring NOW!

Ignorance may be bliss but it leads to many a pitfall—especially when it concerns the true condition of your electrical wiring circuits.

Just how safe is your wiring? Do you really know? Better find out before it's too late . . . before those new defense contracts add an extra burden to what may be already overloaded circuits. Remember, too, that even without that extra strain, authorities agree that nine out of ten industrial plants need rewiring.

Is yours one of them?

Anaconda's "Industrial Wiring Survey" and "Industrial Wiring Guide" will help you find out. The Survey enables you to make a step-by-step analysis of wiring conditions in your plant; the Guide tells you how to correct the conditions found.

Play safe! Send for your free copies now.

Two free books for you! They'll simply, surely find any electrical wiring trouble in your plant; explain how to correct it. Write for them today!

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TAKE the long range viewpoint when selecting your heating and air conditioning equipment. Whether for modernization or new plant construction you're building for the future . . . as well as meeting today's needs . . . when you install Young High Efficiency units. Built with the latest engineering advancements, they deliver dependable, stand-out performance . . . year in and year out . . . at substantial savings in maintenance cost. Flexible in hook-up and available in a wide selection of types, sizes, and capacities . . . they meet the most varied heating and air conditioning requirements. Solve your present problems with an eye to the future . . . specify Young equipment. Write for details.

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Play Tells Company Story

(*Continued from page 57*)

and yet give a story complete enough to help each employee visualize the part he plays in relation to the whole? These and many other snags proved baffling—but not for long.

"Let's resort to showmanship in this delicate 'selling' problem," said the director. "Let's present a play!"

A play? Yes, that was the thing. It would provide entertainment for all the employees and their families; give each employee an opportunity to participate as a member of the cast, rub elbows with top executives, and meet them on equal footing socially through rehearsals and performances of the play. It would build a spirit of mutual understanding and give each individual a pride of accomplishment; reveal what their loyalty and support mean in the major, constructive purposes of the corporation and the nation's defense. Most of all it would furnish an intimate picture of what is essential to continued corporate success, which reflects in steady jobs for all, increased employment, and opportunities for advancement.

But what on earth kind of play could ever achieve all these aims?

The answer to this all-important question was "It's Always Fair Weather," a fast-moving play whose 22 scenes maintained interest throughout. Although some of the material presented during the two acts was historical, there were "no dull moments" experienced by the audience whose generous response necessitated not one performance, as originally intended, but three, so everyone who wanted to could see the show.

Enjoyed by Cast and Audience

Of musical comedy design, with attractive chorus routines, modernistic settings, and a work-a-day romance, the play was enjoyed not only by the audience but also by the cast of 50 who thoroughly enjoyed reaping the reward of their several weeks of intensive rehearsal.

A pattern of continuity was woven with the romance of Johnny, a factory worker, and Mary, an office stenographer. Original melodies and lyrics, dance sets, and light humor provided adequate contrast for the briefly presented momentous events relating to the founding of air conditioning by Dr. Willis H. Carrier; the portrayal of the part air conditioning and refrigeration are playing in national defense; the behind-the-scenes story of the cor-

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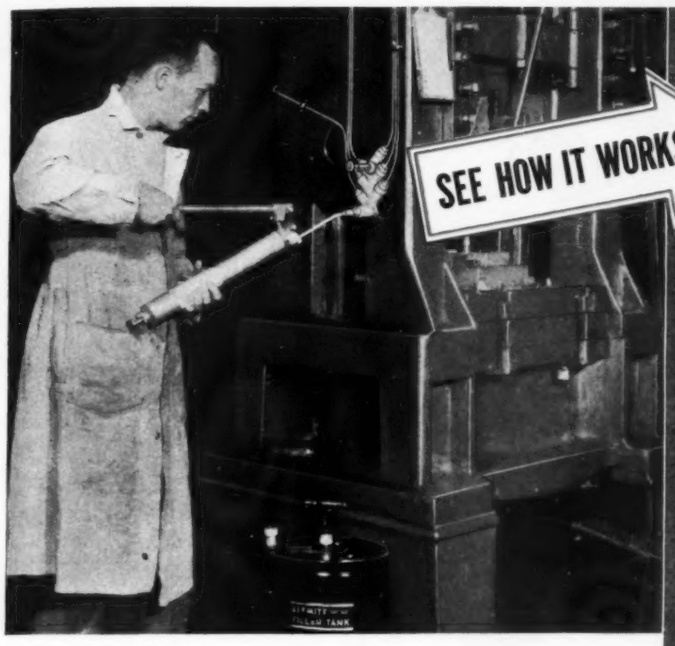

Delivers Pre-determined Quantity of Grease to Each Bearing—Signals When Lubrication is Completed

ALL INDUSTRY is feeling the emergency demand for stepped-up production! Machines and men are being taxed *to the limits of endurance.* Under such conditions it becomes vitally important to make every man-hour, every machine-hour show maximum results in terms of finished products. And positive, dependable lubrication *becomes an absolute "must"!*

The Alemite Progressive Lubricating System insures dependable, positive pressure lubrication. It speeds lubrication. It promotes safety by bringing remote bearings into easy reach. *It permits lubrication while machinery is in operation,* saving machine-hours and man-hours and increasing output. It may be serviced from one central point by either a power or manually-operated grease gun.

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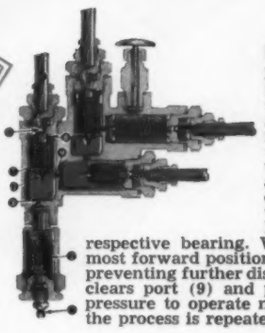
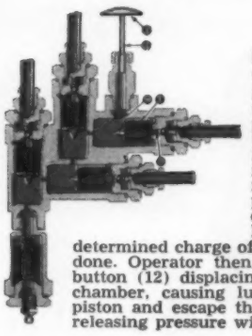


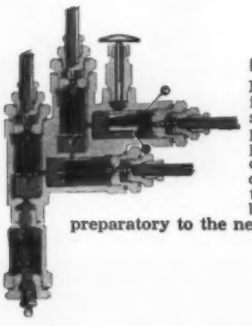
DISCHARGING

Lubricant enters through fitting (1) and is filtered thru strainer (2). Pressure forces valve (3) from seat on intake port (4) moving piston forward (5). Lubricant ahead of piston forces open valve (6) permitting grease to pass into lubricant line (7) and its respective bearing. When piston reaches its most forward position it seats and seals (at 8) preventing further discharge of lubricant. This clears port (9) and permits lubricant under pressure to operate next valve in series, and the process is repeated.



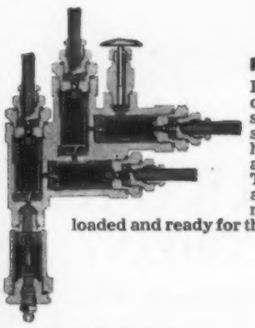
DISCHARGED

The system is shown in its fully discharged position. At this point the last piston (5) clears indicator port (10) allowing lubricant to enter under indicator shaft (11) and moving it to outward position, signalling the operator that all bearings have received their predetermined charge of lubricant and the job is done. Operator then pushes down indicator button (12) displacing lubricant in indicator chamber, causing lubricant to by-pass last piston and escape thru milled slot (13) thus releasing pressure within the system.



RELOADING

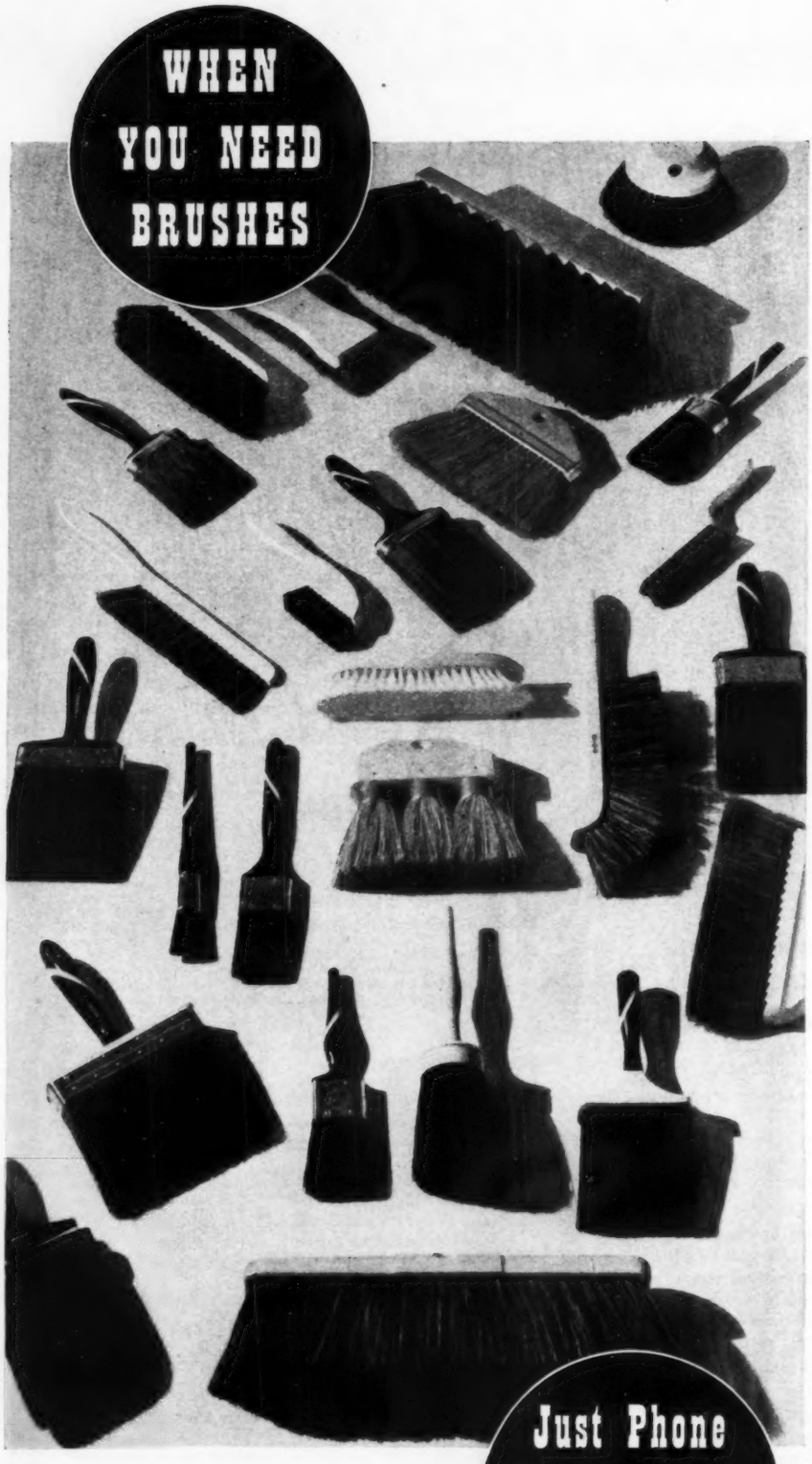
Release of pressure within the system permits the springs (14) to return the pistons to their original positions. The lubricant displaced by the return of the piston by-passes thru groove (15) to chamber ahead of the piston, preparatory to the next lubrication.



RELOADED

In this illustration the original position of the system is shown. The self-aligning valves are held in a seated position against the intake ports. The outlet check valves are closed. The system is not under pressure. It is loaded and ready for the next lubrication cycle.

Ask Anyone In Industry!



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WAREHOUSES IN 81 IMPORTANT MARKET AREAS

poration's organization, stockholders, and objectives; and the revelation of the company's birth, growth, and various activities.

This application of the dramatic art is reported to be the first attempt, through the means of skits and songs, to stabilize employee morale, to acquaint employees and their families with the inner workings of big business, and to make them feel that they have an important part in the progress and development of the company.

One of the highly dramatic scenes was the national defense finale to Act I. Ushered in with the screaming of dive bombers, the rat-a-tat-tat of machine guns, the earth-quaking bursts of bombs, and the distant report of anti-aircraft batteries, the entire cast, in total darkness, began a weird chant of "no blackouts here, no time to lose, Carrier does its part." This fantastic patter was contrasted by the higher-pitched female "faster, faster, faster" lines and the bass-level male retorts of "speed and precision." The climax was made even more eerie by individual facial spotlighting in rapid succession as the tempo of the chant assumed the blood-stirring rhythm of a savage warpath tomtom.

Who Owns Company Stock?

"Who Owns the Company?" and "A Slice of the Average" were light-humored sequences that paraded before the audience the various types of people, much like themselves, who own stock in the company—stenographers, nurses, dentists, engineers, and housewives.

The span of 39 years covered by the play emphasized humorously the days in which the company originated. The no-bend, no-burst "Good Old Days" of the bustle brought rounds of laughter and contrasted the modern mood of the jitterbug scene which opened the show.

A cards-on-the-table, question-and-answer discussion just before the grand finale furnished inspiration to employees and gave them reasons for confidence in the management. At this point, Johnny and Mary, voicing the views of each employee, put the top man "on the spot." President Lyle, in regular Adams-Kieran-Levant style, volleyed the replies to the "information please" about the future of the corporation from the individual worker's standpoint.

"We All Belong" signaled the grand finale, a setting that was spurred by a martial melody. This permitted a personal message to each employee from the president who, as a member of the cast, joined hands with the group and "swung on down" with the chorus in vigorous voice.

In retrospect the performances cre-

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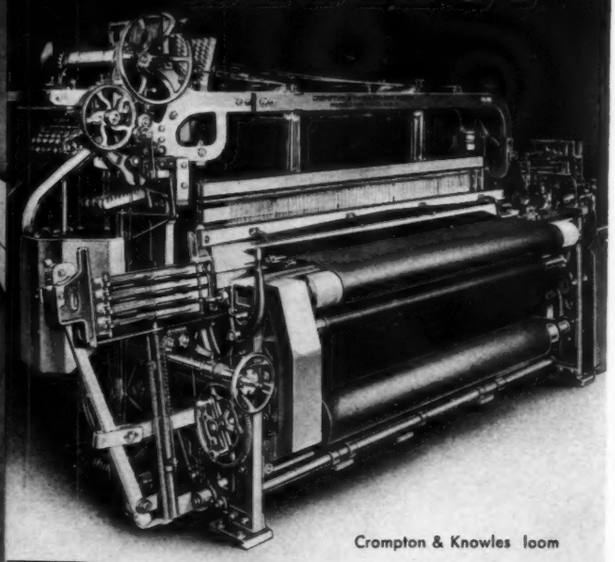

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1558

ated a new interest on the part of employees, established a bond of mutual understanding and a feeling of closer kinship. Many other intangibles cannot be measured, but it is evident that employees' families, who in moments of relaxation after hours influence employee frame of mind, were among the first to express their thanks for a job well done in their interest.

The entertainment slant of this corporation-employee relations program caught on in Syracuse and can do as much for other manufacturers. It presented the needed facts without detracting from the enjoyment of the play. It has lifted the veil of mystery that shrouded the corporation's good intentions and has aided in creating a new pride of accomplishment, a fresh start for all to tackle the big things ahead that will make each employee glad he is responsible for and active in keeping leadership in the industry.

Foremen "Eat Up" This Work-Simplification Course

(*Continued from page* 61)

operation had previously improved it, and lowered the labor cost. He thought he had done a pretty good job until motion study principles were applied. He was thoroughly sold.

Evidence began appearing that these men were thinking of their own departmental operations with an eye to the application of motion study.

Meeting No. 6

Since one foreman had some improvement ideas on a particular operation, movies were made of the method and shown to the group. Many comments were made on what was wrong with the job and the necessary improvements were pointed out, some suggesting that the product be redesigned to facilitate and speed up production methods.

The foreman in charge of this operation adopted a defensive attitude, trying to justify the existing method. He finally agreed to the possibilities of the new ideas, when it was stressed that we must always look for the good in new thoughts before proceeding to tear them down. The job observation also pointed out a hazard of which the operating foremen had been unaware. The effect was impressive.

At this time the first improved method was completed and installed by one of the trainees. The method change was described, the results were tabulated (see page 60) and, with full credit given the foreman, copies were

passed out to each member of the group, as well as to the production manager of the department, and the staff, production, and general superintendents of the division. The men appeared highly interested in the names of those to whom carbon copies were sent. This procedure was used as an incentive to get methods improvements under way.

A production manager who had men enrolled in the classes made the statement that his men were becoming so motion-conscious that improved methods were being applied to him. He told how he had picked up some returned goods from a case and had been using one hand while he inspected them, when one of his men approached him with the idea that he use both hands, and inspect two pieces at a time.

(First installment of a two-part article. Second installment will be published in an early issue.)

Private Pensions and Social Security

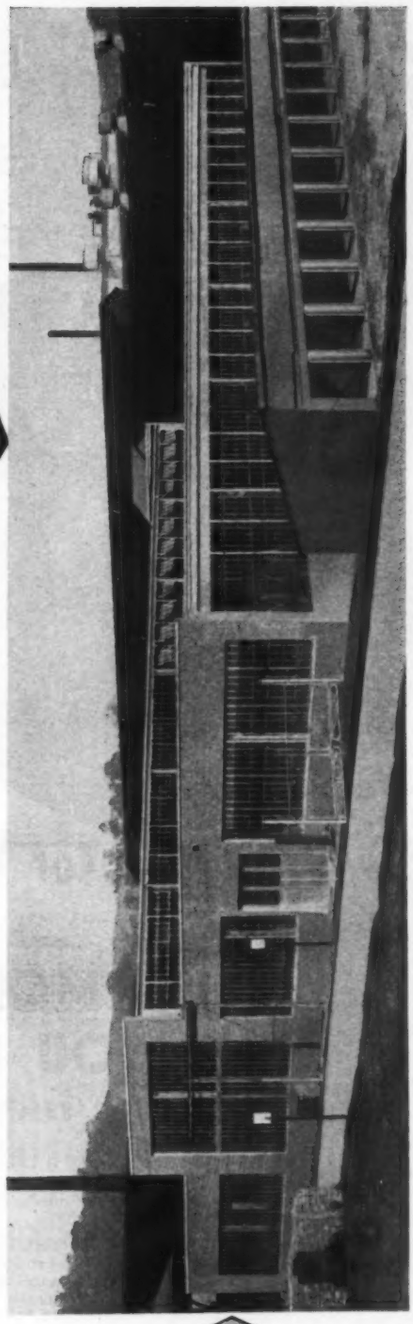
(Continued from page 61)

less feasible to consider any system of exemption or transfer of credits.

With the acceptance of the federal old-age insurance system as a going program, most private plans were faced with the alternative of an increase in total retirement benefits for their pensioners, and an increase in pension costs, or the necessity for amendment. Even some plans which had a provision that benefits might be reduced by the amount of any pension toward the cost of which the employer was required by law to contribute, have been amended to accomplish their purpose more specifically. Such amendments avoid also any possible doubt, which might arise from the separation of the benefit and taxing titles of the federal program, that the employer is required by law to contribute to the federal old-age pension.

Two general methods have been used for the modification of private plans. The first has been described as the offset or envelope method, and may be identical in effect with the provision cited above. The amount of reduction in the private benefit may be either one-half or the full amount of the federal benefit. The deduction of the full benefit in a non-contributory private plan would apparently reduce the employer's pension costs by half the value of the federal benefit, and shift this part of the cost

90 days—FROM CONTRACT TO OWNER'S KEY



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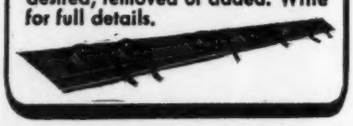

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to the employees. This effect is modified somewhat because there are usually additional benefits in the federal system not found in the private plan. The additional federal benefits will also usually increase the pension costs for the employer when one-half the benefit is deducted in case of a non-contributory plan, or the full benefit is deducted in case of a contributory plan. Temporarily, while the tax rate is below the maximum, any of these reductions should reduce the current pension outlays.

The use of the offset method generally implies an exact determination of the amount of the federal benefit. Since the old-age and survivors insurance records are confidential, this would necessitate the willingness of the employee to disclose the amount of his benefit, and possibly some delay upon retirement, before the exact benefit can finally be determined. In some plans these difficulties have been avoided by determining the amount of benefit to be deducted from the service record since 1937 with the employer operating the pension plan, by applying the formula of the federal system for computing benefits to that record only.

Supplementary Formula Method

The second general method of adjustment may be described as a supplementary formula method. The benefit formula of the private plan is modified to produce roughly, but not exactly for each individual, the same benefits that would be produced by the offset method. This may be accomplished by reducing the amount of pension credit for each year of service, or by introducing age, service, or wage limitations in the requirements for eligibility for membership in the pension plan. It may also be accomplished in part by providing smaller past service credits when a new pension plan is established.

There are, and probably will continue to be, substantial areas in which the purposes of most private pension plans will require the continuance of existing plans as supplementary plans and the establishment of new supplementary plans. Some of these are:

1. To provide large enough benefits to secure the willing retirement of superannuated employees. The federal insurance system may serve well as a means of avoiding destitution among unemployed older workers, without providing large enough benefits to induce workers to retire willingly. To serve this purpose, supplementary amounts of private pensions are needed for all except possibly the lowest paid classes of employees. Employees whose earnings exceed $3,000 a year do not present a major social

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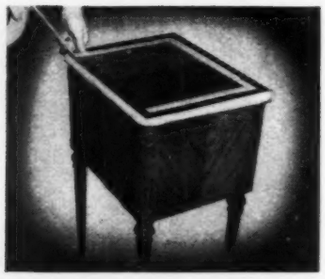

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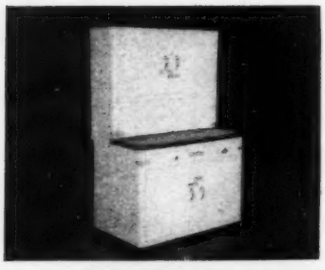

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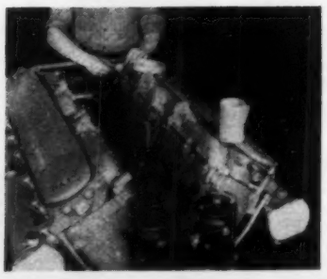

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problem and, hence, receive proportionately very small benefits under the federal plan. However, such employees may be an important problem for the supplementary private plan.

2. To provide flexible and, therefore, more effective retirement provisions. For some groups of employees, such as women or men in hazardous employments, retirement may be expedient or necessary before age 65. The federal plan is not easily adaptable to the needs of such special groups. The private plan can make provision for these employees by paying the full benefit up to age 65 and supplementary benefits thereafter. Individual employees also frequently should be able to retire before reaching 65. The private plan can provide for the optional retirement prior to 65, more effectively to serve such employees and their employers.

3. To provide disability benefits. Benefits for disabled employees, when the disabilities are of long duration, may be anticipated as an addition to the present federal system. In the meantime, they continue to be an area for private pension plan operations. Even with the inclusion of disability benefits in the federal plan there will probably be many individuals, whom the employer would consider disabled but who might not be considered sufficiently disabled to qualify for federal benefits. A supplementary pension plan providing supplementary amounts of disability pension, and providing flexibility for the employer in determining disability, would probably be advantageous.

Conveyor Pays Out in Year

(Continued from page 65)

all seems simple indeed. Upon fully realizing the need for action last year, we talked of gravity chutes from floor to floor, and the transfer of all packing away from the machines where the boxes are made, a large spiral chute on the outside of the building, and other more or less elaborate plans for accomplishing our purpose.

We finally called in the representative of a reliable conveyor concern to whom we presented our problem, giving our suggestions of the simplest arrangement we had been able to conceive. Plans were drawn up promptly and, after a few minor obstacles were removed, we were given a figure for the proposed unit.

Our next job was to sell the idea to our works manager and company officials. As we didn't have anything

12 RLM Specifications

HELP *Industry Provide Efficient and Effective Lighting for Speeding Up* **DEFENSE PRODUCTION**

This Certificate on Your

LIGHTING EQUIPMENT

Insures Uniform High Quality

. . . TROUBLE-FREE OPERATION

● Today, the RLM LABEL as a recognized certificate of uniform quality and a warranty of conformance to rigid quality standards, provides a potent tool both in protecting eye sight and health of workers and increasing production efficiency.

With the same exacting laboratory and engineering tests as were employed in establishing quality standards for the original RLM Dome Reflector, the RLM STANDARDS INSTITUTE has now set up equally effective standards for eleven other types of Lighting Reflectors and Fluorescent Lighting Units for use with MAZDA lamps.

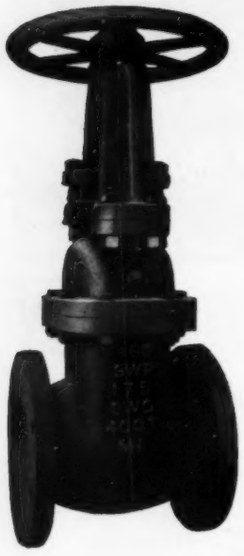
Through the use of RLM Official Standard Specifications, covering vital construction and performance requirements for each of these 12 Reflectors and Lighting Units, you secure positive assurance that your RLM Certified Products provide the maximum value in lighting efficiency and economy . . . will deliver the balanced lighting so essential to maximum output of defense products and the welfare and efficiency of employees called upon to work longer hours and at new high speeds.

RLM Specification No. 1: Dome Reflector
RLM Specification No. 2: Deep Bowl Reflector
RLM Specification No. 3: Symmetrical Angle Reflector
RLM Specification No. 4: Silvered Bowl Diffuser
RLM Specification No. 5: 48″ Fluorescent Two-Lamp Closed-End Porcelain Enamel Unit
RLM Specification No. 6: 48″ Fluorescent Three-Lamp Closed-End Porcelain Enamel Unit
RLM Specification No. 7: 60″ Fluorescent Two-Lamp Closed-End Porcelain Enamel Unit
RLM Specification No. 8: 60″ Fluorescent Two-Lamp Closed-End Poreclain Enamel Diffuser Unit
RLM Specification No. 9: 48″ Fluorescent Two-Lamp Open-End Porcelain Enamel Unit
RLM Specification No. 10: 48″ Fluorescent Three-Lamp Open-End Porcelain Enamel Unit
RLM Specification No. 11: 60″ Fluorescent Two-Lamp Open-End Porcelain Enamel Unit
RLM Specification No. 12: 60″ Fluorescent Two-Lamp Open-End Porcelain Enamel Diffuser Unit

Copies of Specifications Mailed Upon Request

The Letters RLM Stand for
Reflector and Lighting Equipment Manufacturers
RLM STANDARDS INSTITUTE
INCORPORATED
307 N. MICHIGAN AVE. • SUITE 1600 • CHICAGO, ILL.
THE CERTIFICATE OF RLM UNIFORM QUALITY

YOUR FACTORY IS
No Better than its Pipe System



Install

VALVES
HYDRANTS
and
PIPE LINE
ACCESSORIES

Watch your factory pipe lines. Continued operation and heavy production are a strain on any factory. M & H products are widely used and well known for high quality material and expert workmanship. They have been used in industrial plants for many years for conveyance of water, gas, steam, oils, chemicals, and are available in all commercial sizes from 2" to 30".

M & H GATE VALVES are cast iron body, bronze mounted, with double-disc parallel seat or solid wedge top, non-rising stem or outside screw yoke. They come either with flanged or screwed connections. Valves for fire protection lines are marked "WA-FM" to denote approval of both the Underwriters and the Factory mutuals.

M & H FIRE HYDRANTS are revolving head, dry top, bronze mounted. They also are approved by "UA-FM". Entire main valve assembly is removable through barrel without digging. Special Traffic Model is fitted with breakable bolts and stem coupling, designed to break at ground line under impact. Repairs are made simply by renewing bolts and coupling, without shutting off the water.

M & H PRODUCTS INCLUDE

FIRE HYDRANTS	SHEAR GATES
GATE VALVES	MUD VALVES
TAPPING VALVES	VALVE BOXES
WALL CASTINGS	FLAP VALVES
SPECIAL CASTINGS	SLUDGE SHOES
TAPPING SLEEVES	FLANGE AND FLARE FITTINGS
CHECK VALVES	FLANGED FITTINGS
FLOOR STANDS	B & S FITTINGS
EXTENSION STEMS	CUTTING-IN TEES

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

concrete or definite to promise in the way of savings, they were somewhat skeptical, although they acknowledged the need for improvement. However, we were so confident our plan was sound, that we suggested going ahead immediately, agreeing to stand the total expense of the installation out of our factory operating budgets.

On this basis approval was granted, and the conveyor installed. That was about a year ago, and we actually made good on our part of the bargain before the end of the year.

The conveyor is not elaborate or expensive, the total actual cost being less than $2,000. In addition to the other improvements, we have, in the short course of one year, saved not only its cost but considerably more. It is hard to imagine now why we didn't take the step two or three years ago. Each factory has its own problems, which vary according to the nature of work. A conveyor is not necessarily the answer for the relief of crowded conditions in all plants, but in our plant it certainly was just what the doctor ordered.

Carter Products, Incorporated

(*Continued from page 66*)

Ed turned to the next operator.

"Yes, but—" the first man tried to break in. Ed didn't even hear him.

The operator shrugged his shoulders, took the order from the slot opposite his clock number and returned to his machine. Fifteen minutes later he was still standing there, a careless, unconcerned look upon his face—waiting for stock. He had tried to tell Ed . . .

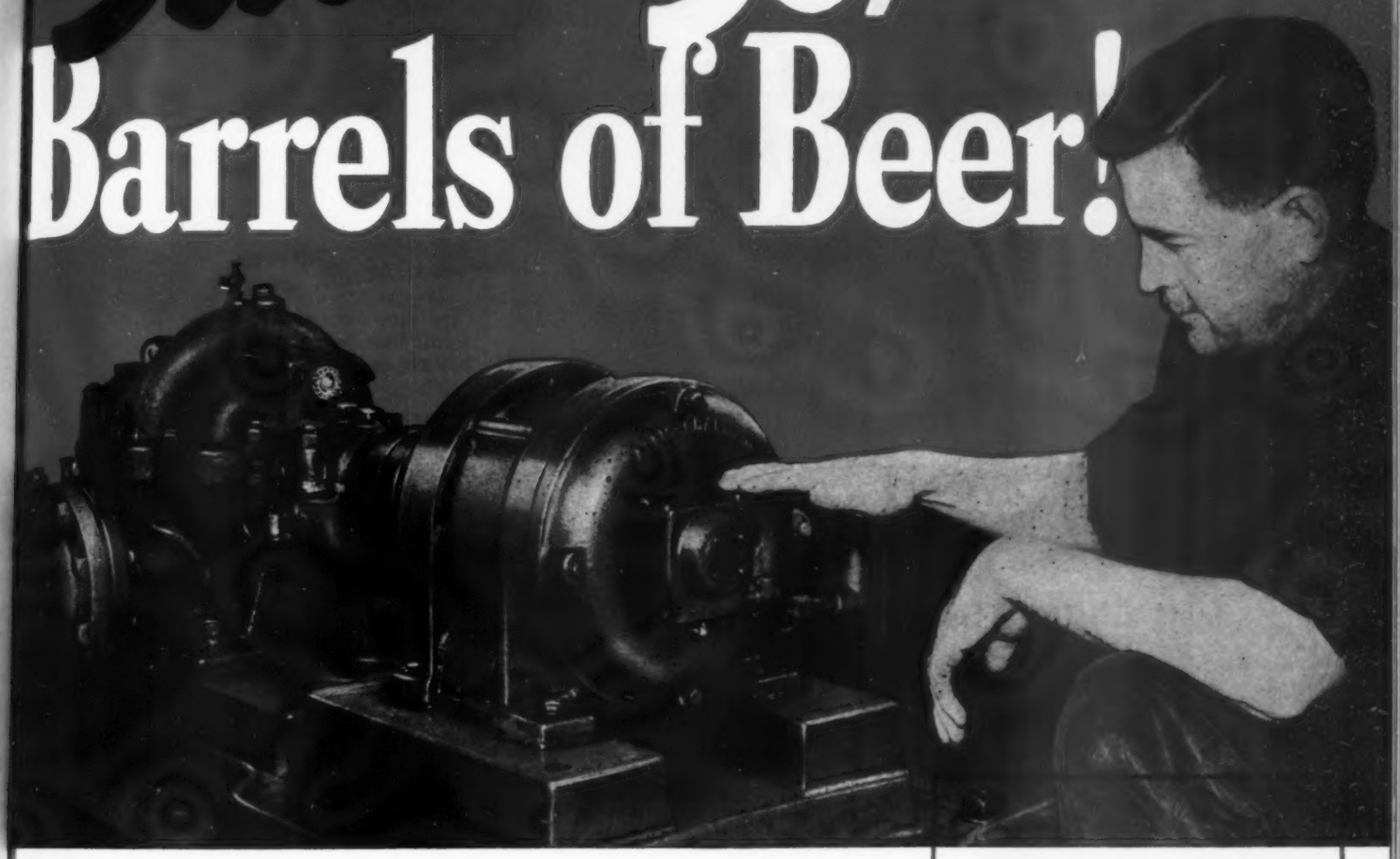
Walt Sparks finally returned to the planning department, after a wearying round of arguments with division heads on rush jobs. One of his assistants told him that Sam Holland, the superintendent, wanted to see him right away. Not caring to think of the reason, Walt went into Sam's office. There he found his boss, Max Carling, ahead of him. At the moment the superintendent and the production manager were discussing the difficult sixth hole at Fair Hill.

"What's the matter with Bate's stuff, Walt?" The superintendent's question was imperative. He was in no mood for excuses. "They were to be taken care of Monday. This is Wednesday. What happened?"

"Shipping is loading the stuff right now," answered Walt evenly. "It'll leave here right away, and be over there inside another hour."

"But why wasn't it shipped Mon-

Saved! 50,000 Barrels of Beer!



THE MOTOR THAT WOULDN'T GIVE UP! B. E. Dutton, Chief Technical Engineer of the Adolph Coors Company, Golden, Colorado, shows how 25 inches of water soaked this Lo-Maintenance Motor. But water didn't stop it, and $500,000 worth of beer was saved!

How Lo-Maintenance Motors Fought a Flood—Kept Refrigeration Going—and Saved the Beer Stock of the Adolph Coors Company in Golden, Colorado.

WHEN A MIDNIGHT cloudburst flash-flooded Clear Creek and Golden Gate Canyons, water flooded the sub-basement, housing auxiliary power plant equipment of the Adolph Coors Company in Golden, Colorado. Before it was discovered, 25 inches of water covered the basement — and threatened the refrigeration of $500,000 worth of beer in storage.

All pumps and motors were immediately shut down, except those necessary to maintain power plant operation. Though partially submerged, the circulating pump and motor of the Turbine condenser *never stopped . . . and it's still running!*

In addition, the Allis-Chalmers pump and motor at well No. 2, which supplies make-up water to the boiler, *ran completely under water for six long hours — and never gave up!*

Altogether — seven Lo-Maintenance Motors that were completely or partly submerged *are operating perfectly today in spite of their punishing experience* — though other motors had to be baked or rewound.

We don't claim that Lo-Maintenance Motors are built for under-water operation . . . but dependable service like this — far more than just a rated horsepower — is one of the outstanding achievements of Allis-Chalmers Motors.

Full-measure construction, distortionless stator, indestructible rotor, high-carbon steel frame and other great extra-value engineering features are your guarantees of trouble-free performance. Get the facts from the trained engineer in the district office near you. Or write Allis-Chalmers, Milwaukee. A-1433

ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND UP

7 BULLETINS TELL THE WHOLE RELAY STORY

A Relay must not only be well designed and well built, but it must also fit the job as to capacity and assembly details for truly efficient operation. Ward Leonard Relays are known for their crisp action, sturdiness and longevity. The scope of the Ward Leonard line permits selection without compromise.

WL RELAY BULLETINS

BULLETIN 105
"Little Giant Relay" single pole, single and double throw. Controls ¾ HP on 115-230V.

BULLETIN 106
Midget Relays for light duty available in single and double pole, single and double throw.

BULLETIN 81
Intermediate Duty Relays in single and multi-pole arrangements, single and double throw.

BULLETIN 131 & 132
Heavy Duty Relays single and multi-pole, single and double throw, contacts rated up to 25 amp. on 125-250V.

BULLETIN 251
Sensitive Type Relays for direct and alternating current operating on .014 watts.

BULLETIN 351
Thermal Time Delay Relays with thermostat built into relay assembly.

BULLETIN 362
Motor Driven Time Delay Relays for operation on alternating current.

WARD LEONARD

Electric Control Devices Since 1892

WARD LEONARD ELECTRIC CO., 55 South Street, Mount Vernon, N. Y.

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Name .....

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day? That's what I want to know! We're two days late now, and I promised them they'd get the stuff."

"Yes," Walt's face flushed as he answered, "you promised 'em. When you asked me if we could do it, I said we'd try, but I didn't see how it was going to be possible."

"Oh, for Pete's sake, Walt!" snapped Sam. "We've got lots of bigger orders than that out of here in four days. Let somebody else wait a couple of days. Let's live up to our promises. When I told them they could have that stuff, I figured you'd find a way. You knew how important it was. Max, I've seen lots of times when we were behind, but I've never seen anything like the past couple of weeks. What's the matter, anyway?"

"I guess," declared Max calmly, "the shop's doing the best it can. It seems like every customer we've got, has had to have shipment right away."

"But," said Sam, "we're not shipping so much stuff. Total shipments are 'way down from what they were two months ago."

"Total volume is off, but the number of orders we have to handle isn't off much." Max Carling's voice was patient.

"Something Wrong"

"Then there's something wrong with our planning," muttered Sam. He reflected that there was always something wrong at Carter's. He could never take an afternoon off for golf; there was always some pressing matter to ruin his day. "We didn't used to have this trouble."

"No," replied Max, "and we didn't used to need the planning that we do now. I've been trying to tell you for a year that we need more help to do the job."

"You've been telling me that we need to increase our overhead and put on more clerks," said Sam Holland scornfully. "Nothing doing; not with present-day prices. If we install an elaborate system of planning, we're sunk."

"Well, then," said Max, raising his eyebrows, "we'll just have to keep on missing the boat, that's all. One of these days some outfit like BM is going to get really sore, and we'll be minus a good customer."

"Will you tell me how we can afford to tack on more overhead?" Sam asked.

Max had held his temper as long as he could. Now he blew up. "It looks like it's either tell you plain out what I think for once, and take a chance on getting fired for it, or later on I'll be looking for a job, anyway!"

"Oh, come on, Max; it isn't as bad as all that!"

"Oh, no?" retorted Max, "Let

MANHATTAN MAKES *arteries* FOR AIRCRAFT

—— *arteries that do not harden in desert heat or stratosphere cold*

BACK of throttle and pedal and instrument panel, a maze of hose made of oil- and gasoline-proof synthetic materials, leads out to wing flap and propeller blade, to rudder and landing gear, to gas line and bomb door, to vital mechanisms that must give instant response to controls.

In them flow the fluids for flying—and landing.

No simple tubing—these arteries that must and *do* stand up to rapid vibrations and extreme pulsations of pressure; to hot engine oil on the inside, sub-zero cold on the outside; to sudden and terrific alternations of stresses and temperatures.

That kind of stamina is an achievement of protracted, progressive and intense research.

But ships must land as well as fly—and then *stop*—quickly, smoothly.

For this vital need, MANHATTAN developed light, high-friction asbestos brake linings for all types of ships from light pursuit to giant bombers and airliners.

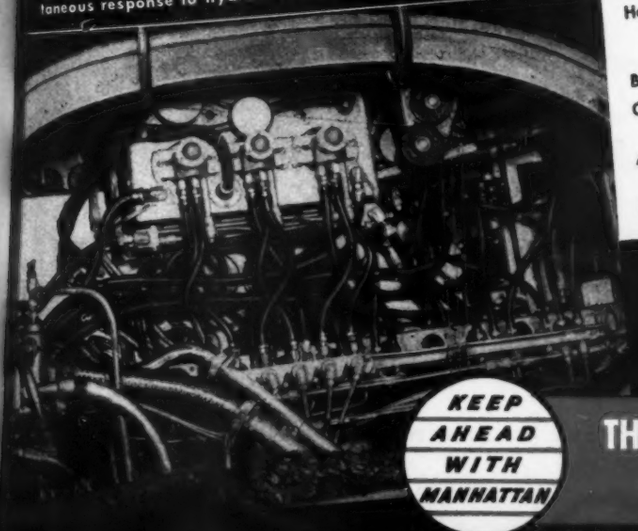
Many other highly specialized developments in natural and synthetic rubber are imperative to the aviation needs of the Defense Program, to which MANHATTAN'S resources, manpower and fifty years' experience are dedicated.

MANHATTAN PRODUCTS

for the Aviation Industry include:

- Hose for Fuel and Oil Lines and Hydraulic Controls
- Brake Linings
- Clutch Facings for Accessories
- Air, Welding & Paint Spray Hose
- Brake Cylinder Cups
- Hydraulic Packings
- Vibration Dampeners
- Molded Parts and Gaskets
- Radio Shielding Tubing
- Abrasive Wheels
- Non-slip Matting
- Transmission Belts
- Conveyor Belts

Behind the instrument panel—Hose developed by Manhattan and The Weatherhead Company engineers assures instantaneous response to hydraulic controls.



KEEP AHEAD WITH MANHATTAN

THE MANHATTAN RUBBER MANUFACTURING DIVISION

of RAYBESTOS-MANHATTAN, INC.

EXECUTIVE OFFICES and FACTORIES • • • PASSAIC, NEW JERSEY

AMERICAN MONORAIL
Increases Plant Capacity

Handling service by American MonoRail cranes over the Nation's largest aircraft assembly floor.

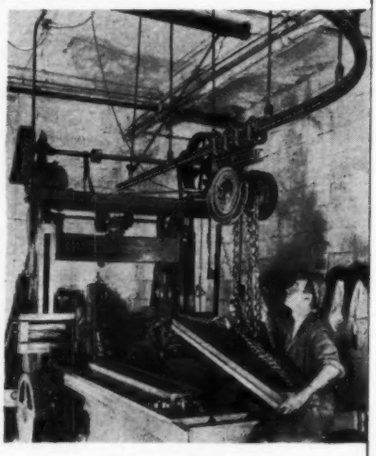
EVERY day more plants are adding capacity by putting their floor space to better use—by putting carrying jobs overhead with American MonoRail.

They find that materials and products are thus kept on scheduled routes—no congestion, no damage in transit.

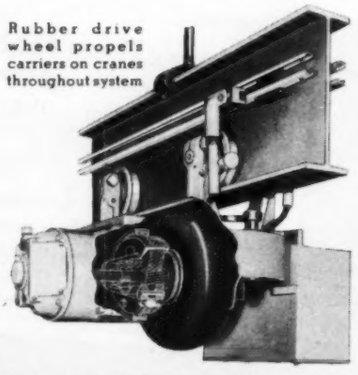
The men, too, relieved from lifting and carrying, give full time and skill to production and accomplish more.

Since standard parts are assembled into complete systems to meet the special requirements of the particular job, the cost of American MonoRail is surprisingly moderate. Operation and maintenance are a minimum. Supplied for manual, electric or automatic operation.

Let us arrange for an American MonoRail engineer to survey your requirements at no obligation.



Easy placing of heavy die blocks in planer with no damage to dies or machinery.



Rubber drive wheel propels carriers on cranes throughout system

Write for copy of "Blue Book" showing hundreds of installations.

THE AMERICAN MONORAIL CO.
13114 ATHENS AVENUE CLEVELAND, OHIO

somebody like BM take away their business, and I'll be in the breadline! You say we can't take on more overhead, and I agree. But there's a lot of it in the factory right now. We're paying foremen and clerical help to do the planning and to run down rush jobs—"

"But we didn't used to have this trouble," complained the superintendent. "Why do we have so much of it now?"

"Because we're no longer a production shop, but a combination production and jobbing shop. We get more orders, but the volume is a lot less per order. A piece of equipment that used to handle one job, now has to take care of jobs for ten different customers. The form of our business has changed."

"When it comes to orders for customers like Bates, that sounds like a lot of excuses," said Sam emphatically. "They still order in just as big quantities as they ever did."

"But," protested Max, "they are only one customer We get a lot of orders promiscuously promised for certain dates because no one, and least of all you or the sales department, thinks the planning department important enough to consult. We rush one job and then another; and the first thing we know, regular customers like BM are set aside and not shipped on time. Then they become rush.

"We'll never get out of the production mess we're in until we face the facts on the small-lot business we're gobbling up."

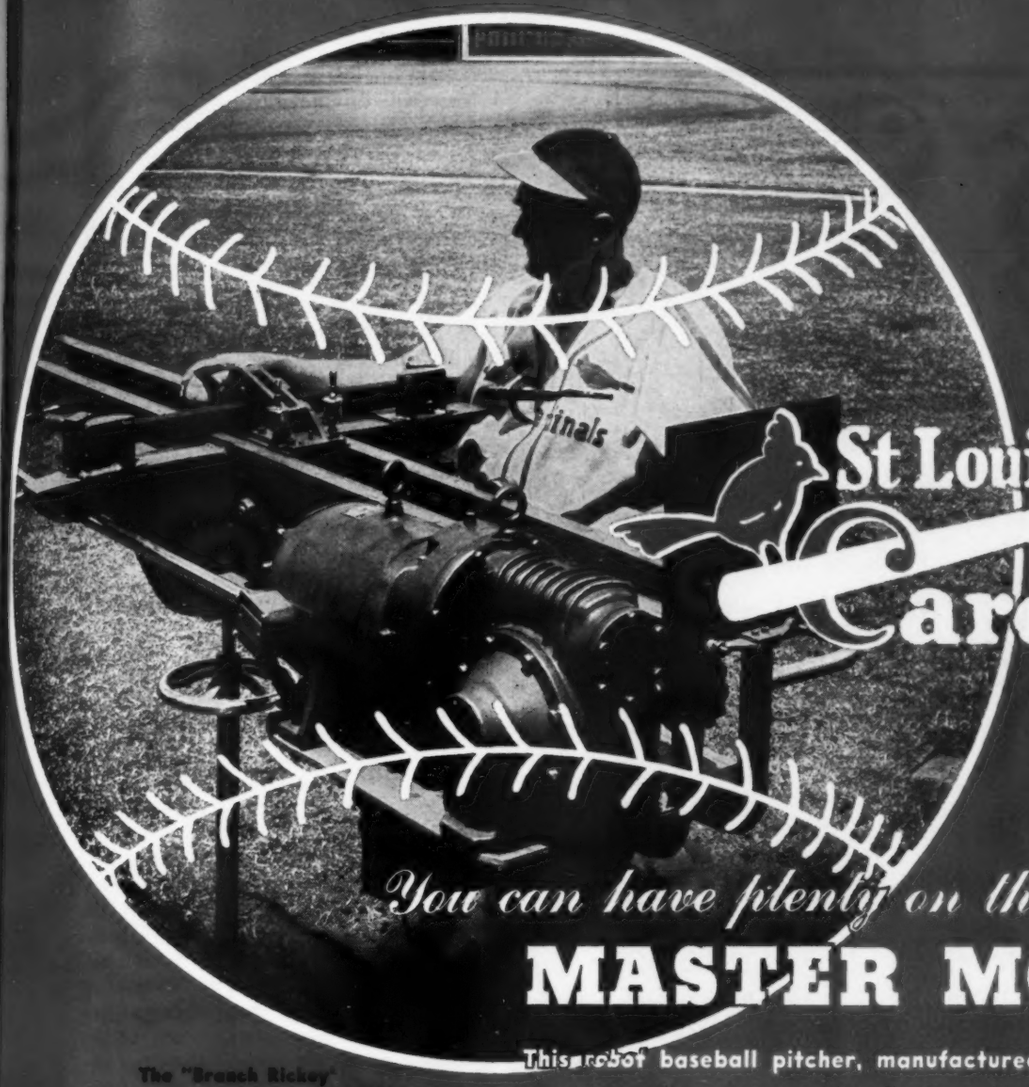
Max sort of "had" Sam on this tirade. Sam wasn't used to have Max talk back to him. You could see he was convinced that Max must be at least partly right, or he wouldn't be so put out. However, our superintendent still refused to admit he was licked. "All I or sales have been trying to do, is maintain our reputation for service," he said rather weakly.

"Yes," agreed Max, "but you have been doing it in a very shortsighted way. You've got our customers thinking that we're miracle performers. It's what it costs to use supervisors as stockchasers, to chop and change from one job to another, to put through orders piecemeal instead of complete, that makes our overhead so high.

"And, incidentally, our customers have less and less confidence in our so-called service. We don't know whether they really need stuff when they ask for it, or whether they're banking on our failure to deliver it when we said we would. Neither they nor we know for sure when we are going to ship anything."

"Well," said Sam, "let's see what we can do."

"Do you mean," Max asked eagerly,



The "Branch Rickey" mechanical pitcher used so advantageously by the St. Louis Cardinals for batting practice is equipped with a 2 horsepower Master Gearhead motor having an output speed of 42 R.P.M.

You can have plenty on the ball . . . use

MASTER MOTORS

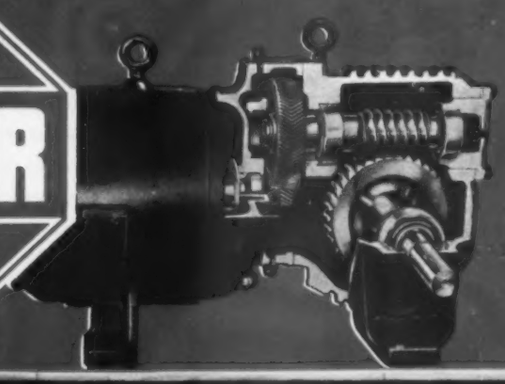
This robot baseball pitcher, manufactured by Baseball Machines, Inc., St. Louis, has helped the St. Louis Cardinals round into a very serious contender for this year's National League pennant. Byron Moser, inventor of this machine, found that a Master Motor built to meet the exact requirements of the job added greatly to the compactness, safety, economy and convenience of this machine.

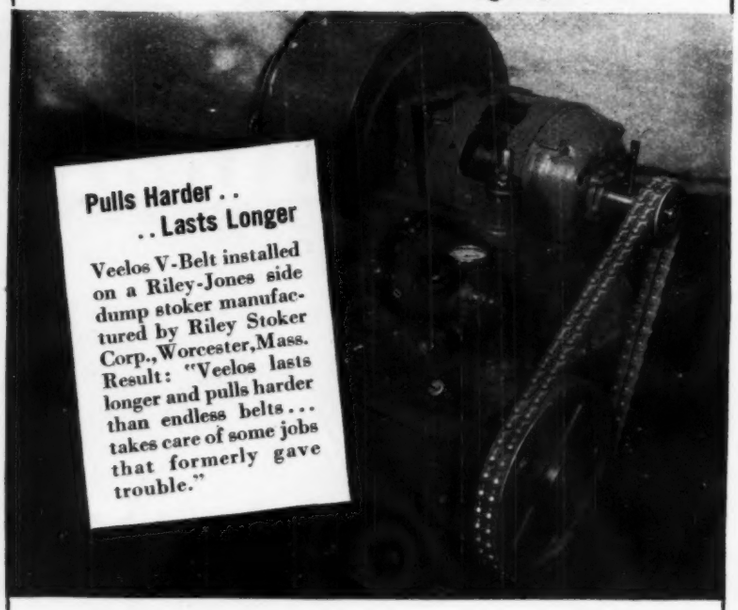
You'll probably never build a baseball pitching machine. But this is one of the thousands of good examples of the advantages that may be secured by using Master Motors that fit exactly the individual requirements of the job.

You too may secure these advantages. Next time you need motors for your plant or your product, investigate MASTER'S unusual ability to serve you advantageously with motors that fit your needs exactly.

THE MASTER ELECTRIC COMPANY • DAYTON • OHIO

MASTER




Pulls Harder . .
. . Lasts Longer
Veelos V-Belt installed on a Riley-Jones side dump stoker manufactured by Riley Stoker Corp., Worcester, Mass. Result: "Veelos lasts longer and pulls harder than endless belts . . . takes care of some jobs that formerly gave trouble."

Keep production rolling with rolls of Veelos—the adjustable, link V-Belt. With a few rolls on hand, production faces no interruptions when belts need to be installed . . . adjusted. Just roll on Veelos in a jiffy! Veelos in rolls provides an automatic supply of matched V-Belts of any length . . . assures continuous production. Ask your distributor.

CALL A V-MAN! When you plan for increased production and the belting angle troubles you, call a Veelos V-Man. He's a sales engineer especially trained in power transmission work. At your service anytime on short notice.

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

VEELOS
V-BELT
ADJUSTABLE to any length
ADAPTABLE to any drive

TRENDS

TREND TO HIGHER SPEED PRODUCTION STARTS TREND TO OCTOPUS FLAT TRANSMISSION BELTING! MORE POWERFUL GRIP ENDS SLIPPAGE! GREATER RESILIENCE STOPS STRETCH! PRODUCED AFTER EIGHT YEARS OF RESEARCH!

"that you want me to install a system that will do the job?"

"Yeah. Go ahead."

Max wondered how much of that statement Sam really meant. And he found out when he asked for final approval of his ideas. Sam knocked down some of the most important.

Things are some better, but the Old Man's son-in-law and our superintendent still likes to do favors for customers he's played golf with.

Walt Sparks still plods along taking the rap, never complaining. Ed Peters still rides a merry-go-round.

Stock in Fifteen Places, But Control in One

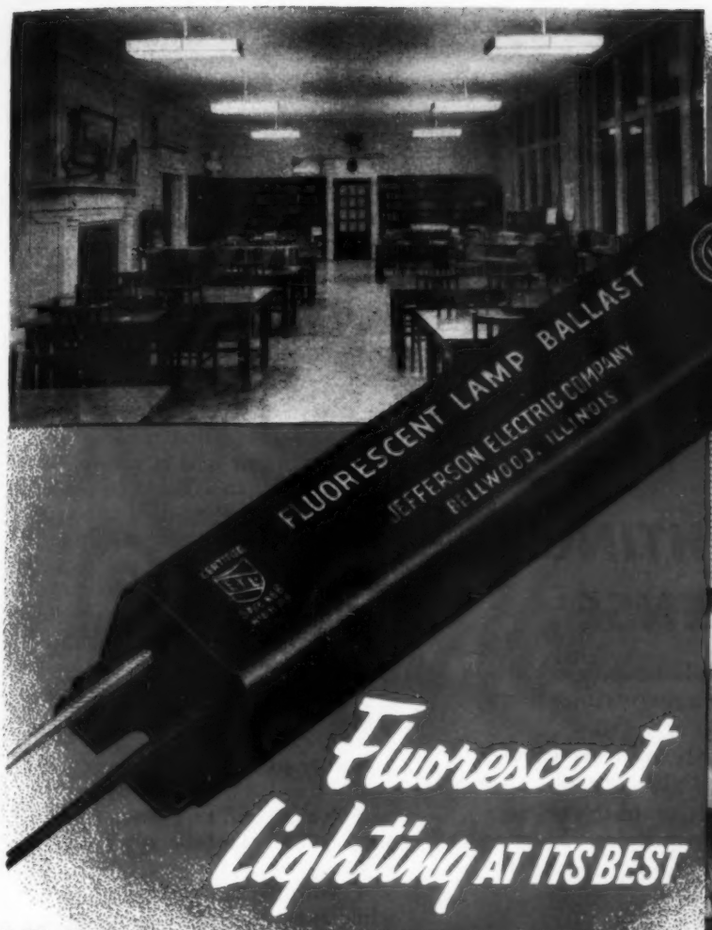
(*Continued from page 70*)

probable number and size of the withdrawals that will be made during the restocking time, and on variations in the restocking time.

On the basis of a mathematical study of these factors, tables were made several years ago to determine the correct ordering points. One important fact was immediately obvious from the study—on the average it costs approximately twice as much to protect an item completely from running out of stock as to protect it against running out once in five years. For many items it would not cause serious inconvenience if an out-of-stock condition occurred with that frequency, and that in general is the amount of protection in the Laboratories at present. However, with this system any degree of protection can be given, and on some special items the ordering point is set for complete protection.

A machine to determine the ordering point is shown in Figure 6. It has different color markings at the top of the columns like those on the stock ordering machine so that any table can be compared readily with the associated column on the front of the machine. The tables show ordering points against running out of stock from once a year to complete protection. Because only the desired amount of protection is given to each stock item, inventory is maintained at an economical minimum.

At present, of course, stock control has been decidedly complicated by general business conditions. Many items are difficult to get; the time of delivery is lengthening; price changes are occurring all the time. Ordering amounts and ordering points are therefore being adjusted to meet changing conditions, and the stock control machines are proving very helpful.



A few of many eminently satisfactory installations of fluorescent lamp fixtures made by P. W. Wakefield Brass Co., Vermillion, Ohio —all equipped with Jefferson Electric Ballasts.

Fluorescent Lighting AT ITS BEST

INSURED BY JEFFERSON CERTIFIED BALLASTS

No question about the improved appearance, improved illumination and greater efficiency provided by properly designed and installed fluorescent fixtures—but for the most satisfactory performance it is well recognized that the ballasts used must be carefully selected.

Experienced fixture manufacturers, engineers and installation contractors know the important part that the ballasts play—and their use of Jefferson Electric Ballasts again attests the quality of Jefferson-made products.

When considering fluorescent lighting specify Jefferson Electric Ballasts for maximum results and minimum servicing... JEFFERSON ELECTRIC COMPANY, Bellwood, (Suburb of Chicago), Illinois. Canadian Factory: 60-64 Osler Avenue, W. Toronto, Ont.

CERTIFIED E.T.L. SPEC NO 6 HIGH P.F.

CERTIFIED BY ELECTRICAL TESTING LABORATORIES

•

LISTED AS STANDARD BY UNDERWRITERS' LABORATORIES, INC.

Lamp design—electrodes, filling pressures, length, diameter, current density, voltage and current, etc.—is based on the best performance of lamps for efficiency, maintenance, life. These basic factors determine the units of electrical specifications for ballasts.

Because of these requirements, the fluorescent lamp manufacturers guarantee the performance of their lamps only when used with those ballasts which meet the specified performance, as tested by Electrical Testing Laboratories, or other laboratories of recognized standing. This is a logical safeguard set up by the fluorescent lamp manufacturers to insure proper lamp performance.

Underwriters' Laboratories' approval of equipment requires that the device meet established standards as far as fire hazard and danger to life and property are concerned. • Your self-interest and the ultimate satisfaction of your customer should prompt you to be sure you get Ballasts with the "E.T.L." Certification label or insignia stamped in the case.

JEFFERSON ELECTRIC FLUORESCENT LAMP BALLASTS

ALL-OUT AID
FOR BETTER LIGHTING TO SPEED DEFENSE

● Faster production in vital defense plants calls for the most modern standards of illumination—with many times more light than in 1914.

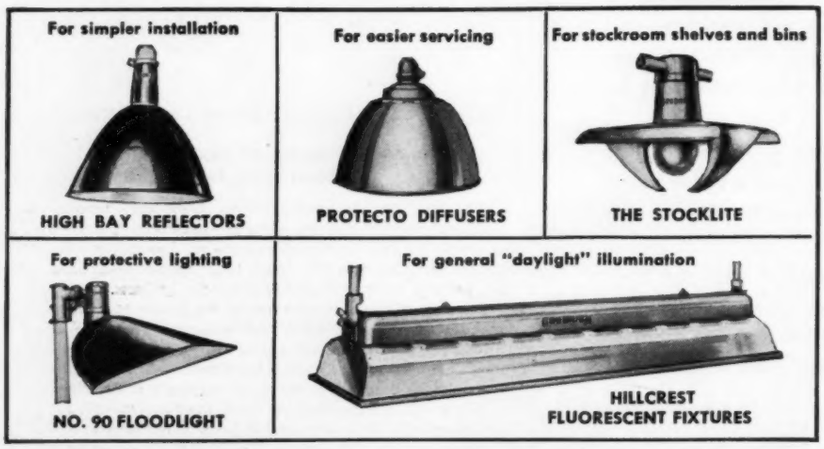
Modernized lighting equipment is the only answer—better, more efficient fixtures which assure proper light control.

Goodrich fixtures have set the pace with up-to-the-minute design to answer every need in defense industries. They're proving everywhere that better illumination means greater production. Catalogs upon request.

GOODRICH INDUSTRIAL LIGHTING

All RLM-approved fixtures are included in the Goodrich line.

Shown below are a few popular styles made exclusively by Goodrich:



SOLD ONLY THROUGH ELECTRICAL WHOLESALERS

GOODRICH
ELECTRIC COMPANY
OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 4604 BELLE PLAINE AVENUE, CHICAGO, ILL.

Foremen Are Seldom Psychologists

(*Continued from page 71*)

rise in a few cases to a feeling of insecurity in the face of these new and puzzling techniques. Therefore a defensive, hypercritical attitude on the part of these people toward the program as a whole was engendered.

In view of these problems of attitude, motivation, ability to deal with abstractions, and intelligence, it was found advisable to revise the program. It is still believed that training in the human relations field is valuable, but no longer will an attempt be made to make psychologists out of supervisors and foremen. No further effort will be made to explain the principles and mechanisms that underlie and determine human behavior. Instead, all effort will be concentrated on habituating the supervisors and foremen to thinking and acting according to three simple and very concrete rules:

1. Always give an employee an opportunity to tell you whatever he has on his mind.
2. Never take any disciplinary action without a thorough investigation of the merits of the case.
3. Never take disciplinary action while angry.

Although there are many other rules that might well have been included, it was thought best to limit the number to these three. By presenting them over and over in a variety of contexts, it is believed that sheer force of repetition will embed them in the group's thinking in such a way that they will come to mind in appropriate situations.

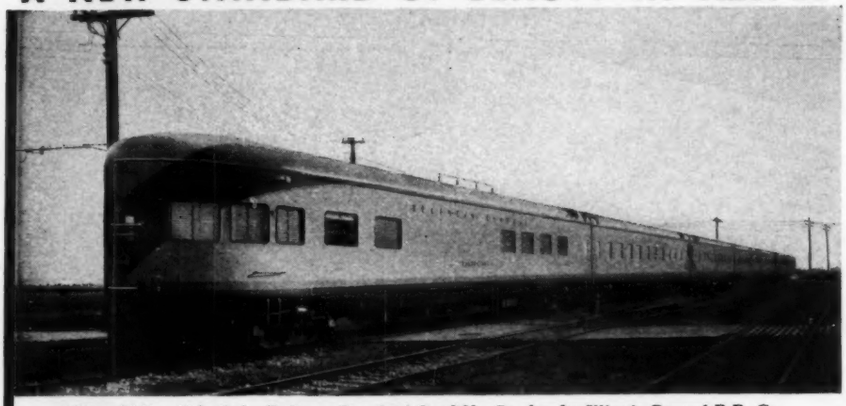
Listen to Grievances

If the foremen and supervisors can be taught to listen sympathetically to their subordinates' grievances, a great deal of employee dissatisfaction can be eliminated and much closer personal relationships established. If each case is investigated before disciplinary action is taken, many injustices may be avoided and animosities prevented. If no supervisor or foreman disciplines while angry, the causes of many hard feelings and accusations of "taking out spite" and favoritism may be avoided.

Such a program admittedly leaves much to be desired in scope and breadth, but on the other hand it is based upon an awareness of the limitations of those who are supposed to benefit from it. For this reason it is believed that in the long run it may prove more practical than more ambitious and elaborate programs.

SKILSAWS
Saw 10 times faster than by hand! Saves time in plant expansion, remodeling, maintenance . . . in shipping and receiving rooms . . . cutting Celotex, Transite, compositions . . . cutting flat or corrugated metals. 9 Models.
SKILSAW BELT SANDERS
Finish finer . . . faster, and at lower cost! All finishing and refinishing is faster in production or maintenance work. Ideal for every job from coarsest sanding to finest honing on wood, stone, metal or compositions. 4 Models.
SKILSAW TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE!
. . . speed up every job that needs doing!
• Industry no longer is marking time . . . it's making time with SKILSAW TOOLS. By saving minutes on every operation, these high-grade tools save hours on each job . . . days on each project . . . weeks in America's defense! That's why more and more SKILSAW TOOLS are on duty throughout the land . . . serving industry better . . . making America's hands more productive.
In your plant are countless jobs that SKILSAW TOOLS can speed. Your distributor will gladly demonstrate them.
Prompt delivery on SKILSAW TOOLS for every defense need!
SKILSAW, Inc., 5043 Elston Ave., Chicago
New York - Boston - Buffalo - Philadelphia
Cleveland - Kansas City - Atlanta - New Orleans
Dallas - Los Angeles - Oakland - Seattle
Toronto, Canada
SKILSAW DRILLS
More drilling power . . . more holes per hour! Speed up all drilling . . . from lightest production work to heaviest boring and reaming in wood, steel and compositions . . . in maintenance or production. 22 Models.
SKILSAW DISC SANDERS
Grind away waste . . . grind down costs! Speed up all filing, grinding, sanding, polishing, buffing and metal cleaning. They work equally well on flat and curved surfaces of wood, metal, stone, tile and compositions. 5 Models.
SKILSAW PORTABLE ELECTRIC TOOLS

A NEW STANDARD OF BEAUTY IN TRAVEL

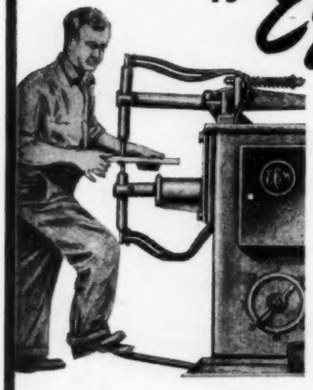


"City of Miami" built by Pullman-Standard Car Mfg. Co. for the Illinois Central R.R. Co. This train operates between Chicago and Miami in 29½ hours.

And the Construction

-AIDED BY *EC&M* WELD TIMERS

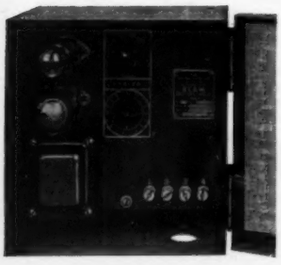
IS *Equally* OUTSTANDING!



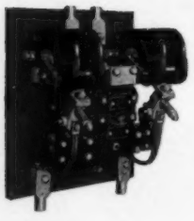
PASSENGERS marvel at the exceptionally beautiful interior of this crack streamliner, "City of Miami." In achieving it, Pullman utilized craftsmanship of a high order.

A portion of the interior steel is joined by welding—using EC&M Weld Timers—thereby obtaining strong, *perfectly formed* joints without indentation and discoloration of the material being welded.

There's no guesswork with EC&M Weld Timers. Timing is *completely automatic.* Strong, uniform welds result. And, in addition, this accurate timing, by safely permitting higher welding current, saves welding time!



In welding stainless steels, galvanized metal, non-ferrous metals, sheet steel, etc., EC&M Weld Timers give outstanding results in both quality and quantity of work. Ask for descriptive Bulletin 1201, also for Booklet 141—a guide on welding procedure for operators.



● As companions for these Timers EC&M has a complete line of Heavy-duty, Fast-operating Welder Contactors to handle the main welding current. They are mechanically sturdy for this exacting service and very efficient. Ask for Bulletin 1211 describing them.

The Electric Controller & Mfg Co.
2700 E. 79th St. Cleveland, Ohio

Look for this Trade-Mark when you buy — specify it when you order

MOTOR CONTROLS • BRAKES • LIMIT STOPS • MAGNETS

Management Shorts

(*Continued from page 72*)

truck drove in, the doors were shut, and the driver got out of his seat and walked up onto the platform. While it is our practice to keep company-owned trucks in first-class condition, we are in no position to know the condition of outside trucks. Therefore we were totally unprepared for what happened next. Our electric truck driver began backing into the trailer with his load. As the rear wheels of the truck hit the floor of the trailer, which was approximately three-quarters of an inch lower than the loading platform, the trailer began to move forward. It was stopped only by the closed entrance doors.

This left the electric truck, with its driver pretty much cooped up, suspended like a bridge between the loading platform and the trailer. Had the doors not been down to stop the trailer, the electric truck might have plunged to the lower level, a drop of 5 feet.

A lucky escape, no doubt, but one we had no desire to have repeated. To avoid a recurrence of the situation—we found the brakes had been set but were in poor mechanical condition and so had slipped—we got out a letter relating the incident. This led to the adoption of wood blocks which were to be placed against the tires of trucks standing before the platform. Large notices have been posted stating that it is the responsibility of the truck driver to see that blocks are placed against his truck wheels before any loading or unloading is done, and that our loaders also must see to it that all truck wheels are properly blocked. We now feel that the accident hazard has been materially reduced.

•

Short movies are used by an eastern plant in its safety program. Scenes showing how to use safety equipment are acted by the company's own employees.

•

Hiring Code Combats "Labor Piracy"

HARRY BENNETT, Executive Secretary
Akron Chamber of Commerce, Akron

Akron Chamber of Commerce sponsors a four-point program aiming at elimination of "hiring-away" practices among Summit County firms. The following defense hiring code was drawn up and sent out for the acceptance and signature of over 430 of the county's largest manufacturing and commercial organizations, and has now been adopted by a group of employers list-

FROM THE TECHNICAL LIBRARY OF KOPPERS

INDUSTRY THAT SERVES ALL INDUSTRY

HOW TO BUILD LONG-LIFE ROOFS OF COAL TAR PITCH AND FELT

HOW TO PROTECT CONCRETE AND MASONRY FROM WATER

HOW KOPPERS COAL CAN SAVE FOR YOU

HOW TO AVOID TROUBLE ON POWER SHAFT CONNECTIONS

HOW TO SAVE CONSTRUCTION MONEY BY USING PRESSURE-TREATED TIMBER

Before you patch your roofs for winter . . . .

read this

Have you ever figured out how much it costs you to repair your leaking roofs . . . labor, materials, damage to contents of the buildings? Many companies are surprised when they finally add up the total. Many company executives, who seldom or never see the oft-repeated trips of the repair crews, do not realize how lusty a total this is.

Do you realize that a new roof of Koppers Coal Tar Pitch can be laid over your old roof . . . and that it will be good for 20, or 30, or even 40 years of service? The cost of the new roof, divided by 20 or 30 or 40, will give you a lower year-by-year cost than the unending bills for repairs.

When you fix up your roofs for winter this time fix them up for good. Let us send you the Koppers Roofing Specification book which tells why it takes Coal Tar Pitch and Tar-saturated Felt to withstand the conditions that attack roofs . . . and how Koppers Pitch and Felt perform under those conditions.

KOPPERS
COAL TAR PITCH ROOFING
AND WATERPROOFING

KOPPERS COMPANY
TAR AND CHEMICAL DIVISION
PITTSBURGH, PA.

Fill out and mail

KOPPERS COMPANY,
1266 Koppers Building, (19) Pittsburgh, Pa.

Please send me copies of these folders:

Your Name.....

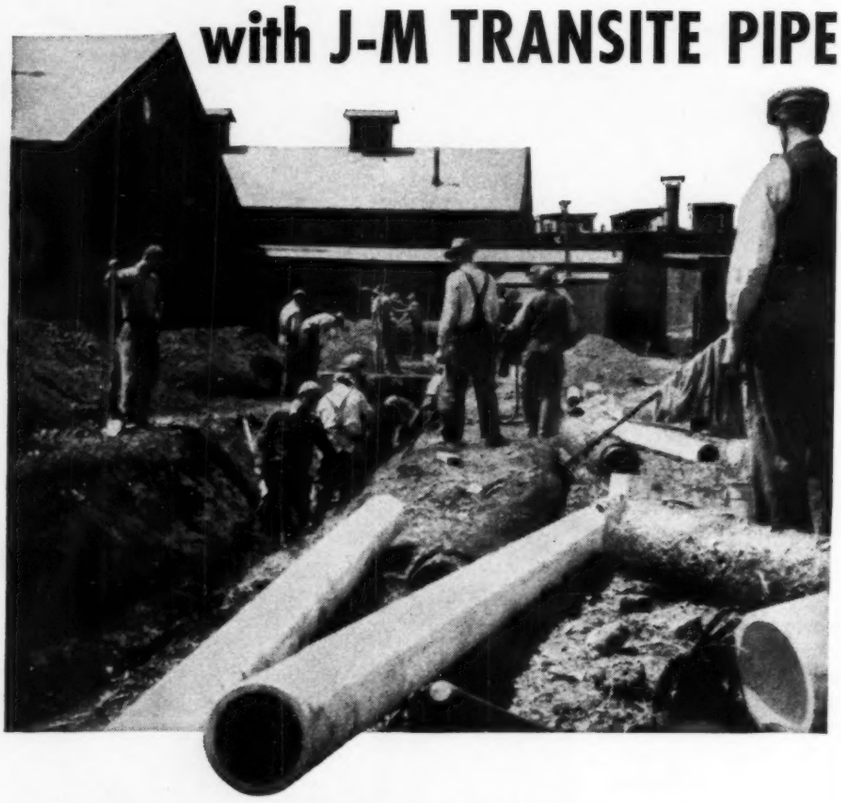
Title.....

Firm.....

Address.....

- ☐ "Roofing Specifications"
- ☐ "Steep Roofs of Coal Tar Pitch"
- ☐ "Water-cooled Roofs"
- ☐ "Membrane Waterproofing Specifications"
- ☐ "Dampproofing Specifications"
- ☐ "Tar-base Paints"
- ☐ "Where to Use Pressure-treated Timber"
- ☐ "Pressure-treated Timber Poles"
- ☐ "How to Paint Creosoted Wood"
- ☐ "Fast's Self-aligning Couplings"
- ☐ "Piston Rings for Diesels"
- ☐ "Piston Rings for Compressors"
- ☐ "Coals for Stokers"
- ☐ "Coals for Industrial Use"
- ☐ "Creosote"
- ☐ "Creosote-Coal Tar Solutions"
- ☐ "Disinfectants"
- ☐ "D-H-S Bronze for Industrial Applications"
- ☐ "Tar Acids"

Guard against rusty water... Keep delivery capacity high with J-M TRANSITE PIPE



Here's why more and more plant operators are specifying this asbestos-cement pipe for *supply* lines, *process* lines, *condenser* water lines and *fire* lines:

Clean water! Made of asbestos and cement, therefore non-metallic, Transite Pipe simply cannot rust. It can never cause "red water" or rusty scale.

High delivery capacity! Transite's smooth interior surface provides an unusually high flow coefficient—C=140. And this high figure is maintained because Transite is immune to tuberculation, the internal corrosion that clogs ordinary pipe and cuts down flow rates. As a result, Transite Pipe keeps delivery capacity up, pumping costs permanently low.

Easily installed! Transite's long 13-ft. lengths are relatively light in weight—easily handled and installed. Simplex Couplings used in making joints in Transite lines are rapidly assembled even by unskilled crews—require no heating or caulking equipment.

For complete details on this modern water pipe, write for brochure TR-11A. Johns-Manville, 22 East 40th Street, New York, N.Y.

Johns-Manville
TRANSITE PIPE
For efficient, economical industrial water lines

ing 90 percent of the Akron wage earners on their payrolls.

1. That employees of other companies shall not be solicited to change to new positions.
2. That every effort shall be made to ascertain if all applicants for positions are employed elsewhere.
3. That when an employee leaves one company for another, one week's notice must be given original employer unless exception is made with consent of both.
4. That all employers will cooperate fully to observe these practices.

•

Cartoon strips in plant employee publications are being used to get personnel policies across to employees.

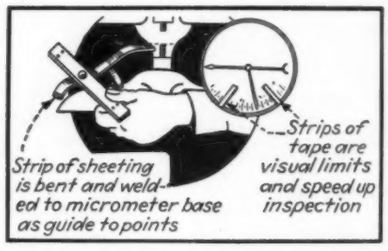
PRODUCTION METHODS AND MATERIALS

Speeded Up a Micrometer Inspection

F. E. STEBLEY, Johns-Manville Corporation, Waukegan, Ill.

Speed of an inspection operation utilizing a table micrometer was stepped up considerably by eliminating undue fumbling of work between micrometer points.

A strip of sheeting was welded to the


Strip of sheeting is bent and welded to micrometer base as guide to points
Strips of tape are visual limits and speed up inspection

"mike" base and bent so that parts could be guided against it into the measuring points. Where tolerances existed, limits were indicated by strips of tape stuck to the micrometer face. When changes in tolerances are made the tapes can be quickly changed.

These applications to the table micrometer resulted in less fatigue to the inspector.

•

Steel Horse Goes Up or Down to Meet Job

E. H. TRICK, San Antonio, Tex.

It seems that no matter what kind of floor is provided for a structural steel fabricating shop it eventually gets rough and uneven.

We had difficulty in supporting in a level position the outer ends of heavy beams

STOP HIM WITH MODINES!

This is the pathetic figure of the man who stuck his neck out. He skimped on the quality of the heating equipment for his factory and office.

Now he has Simon Degree on his neck. And his troubles are just beginning . . . because Simon Degree is ineffective, inadequate heating in person.

This short-sighted man could have had the *proved* precision heating of Modine Unit Heaters for a very few dollars more. But he bought on price alone—and five years from now he will pay for it many times over in increased cost of operation.

Modines—America's Recognized Standard

If you're building or modernizing or expanding your facilities, you don't have to cut cost corners on heating equipment—*not these days.*

The advanced design . . . the superior quality of material and construction of Modine Unit Heaters will give you automatic, fast, effective, economical heating . . . not only *now*, but *years* from now. And Modines are more adaptable to varying spaces and needs . . . more flexible to meet changes in plant and production conditions arising in the future.

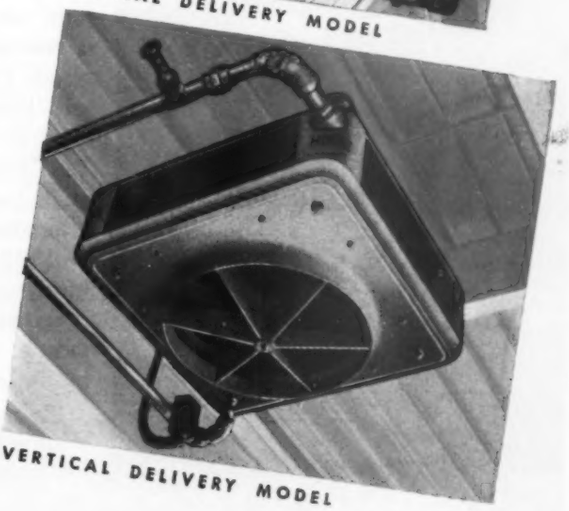
Horizontal or Vertical Delivery models in sizes to meet your exact needs. Recently expanded Modine production facilities assure delivery as prompt as any in the industry.

Write for the latest literature

MODINE MANUFACTURING CO., 1730 Racine St., Racine, Wis.

Look in your phone book for Modine representative's name —"Where to Buy It" section under Heating Apparatus.

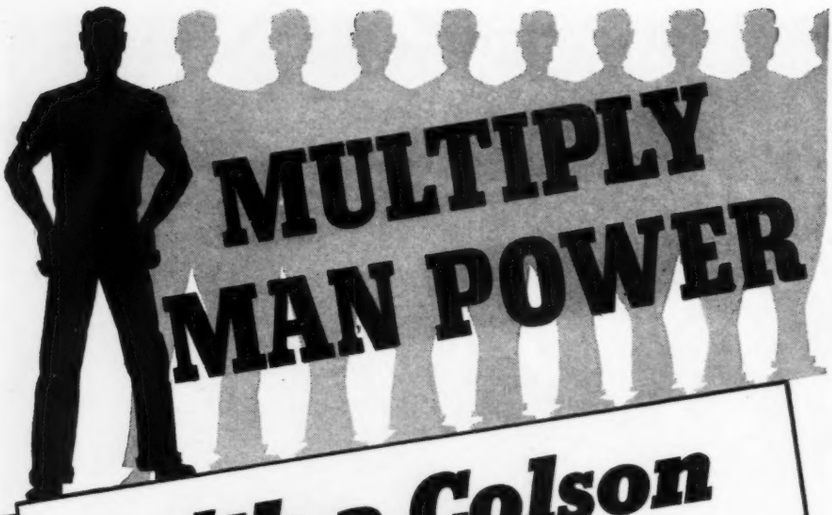
HORIZONTAL DELIVERY MODEL



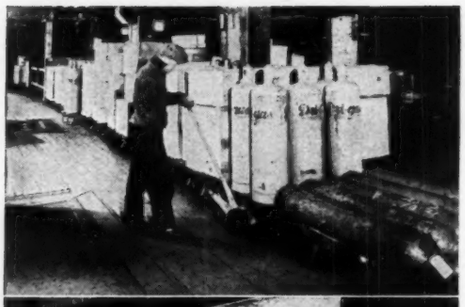
VERTICAL DELIVERY MODEL

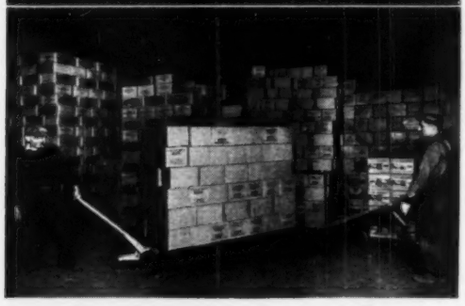
modine

THE UNIT HEATER THAT IS FASTER AND EASIER TO INSTALL



MULTIPLY MAN POWER with a Colson Lift Jack System





TODAY, when man power *must* be multiplied to the utmost and fast-increasing production calls for greatest efficiency—the Colson Lift Jack System is one way of putting skids under handling costs.

The Colson System is *complete* and eliminates extra pick-up, extra set-down and extra handling.

The Colson System is *simple*. Two units do the job. A platform with wheels on one end; a two-wheeled jack that engages the front of the platform and converts it into a sturdy, easy-to-roll truck.

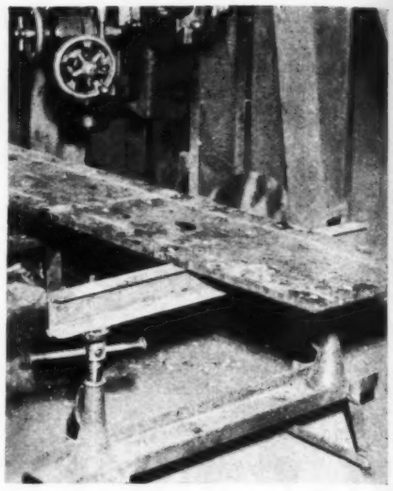
The Colson System can be installed with a *small* investment. A hundred dollars will buy several platforms and a lift jack. Many users report that their total investment was returned in less than a year in actual savings made in handling costs alone.

To multiply your man-power, ask us for more complete information

THE COLSON CORPORATION
ELYRIA, OHIO
Offices and Agencies in Principal Cities
CASTERS • INDUSTRIAL TRUCKS AND PLATFORMS • LIFT JACK SYSTEMS

when drilling their webs in a large radial drill press. The crane not always being available for this service, we used a heavy wooden horse supplemented with wooden blocks, and strips of steel for shims.

The adjustable steel horse shown here solved our difficulty. It consists of a low horse made of channel iron, equipped with stoutly welded legs. Upon this are



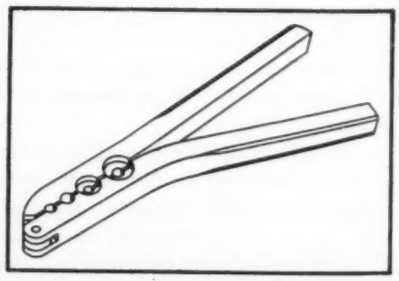
placed two screw jacks of a suitable size, one near each end. The tops of the jacks are welded to a light beam that forms the top member of the horse, carrying the load. No matter how uneven the floor may be, the outer end of the beam that is being drilled may readily be leveled by adjusting the screw jacks. When made of suitable lengths these horses serve a wide variety of uses in a structural jobbing shop such as ours.

•

Small Parts Holder for Drilling or Tapping

CHAS. H. WILLEY, Penacook, N. H.

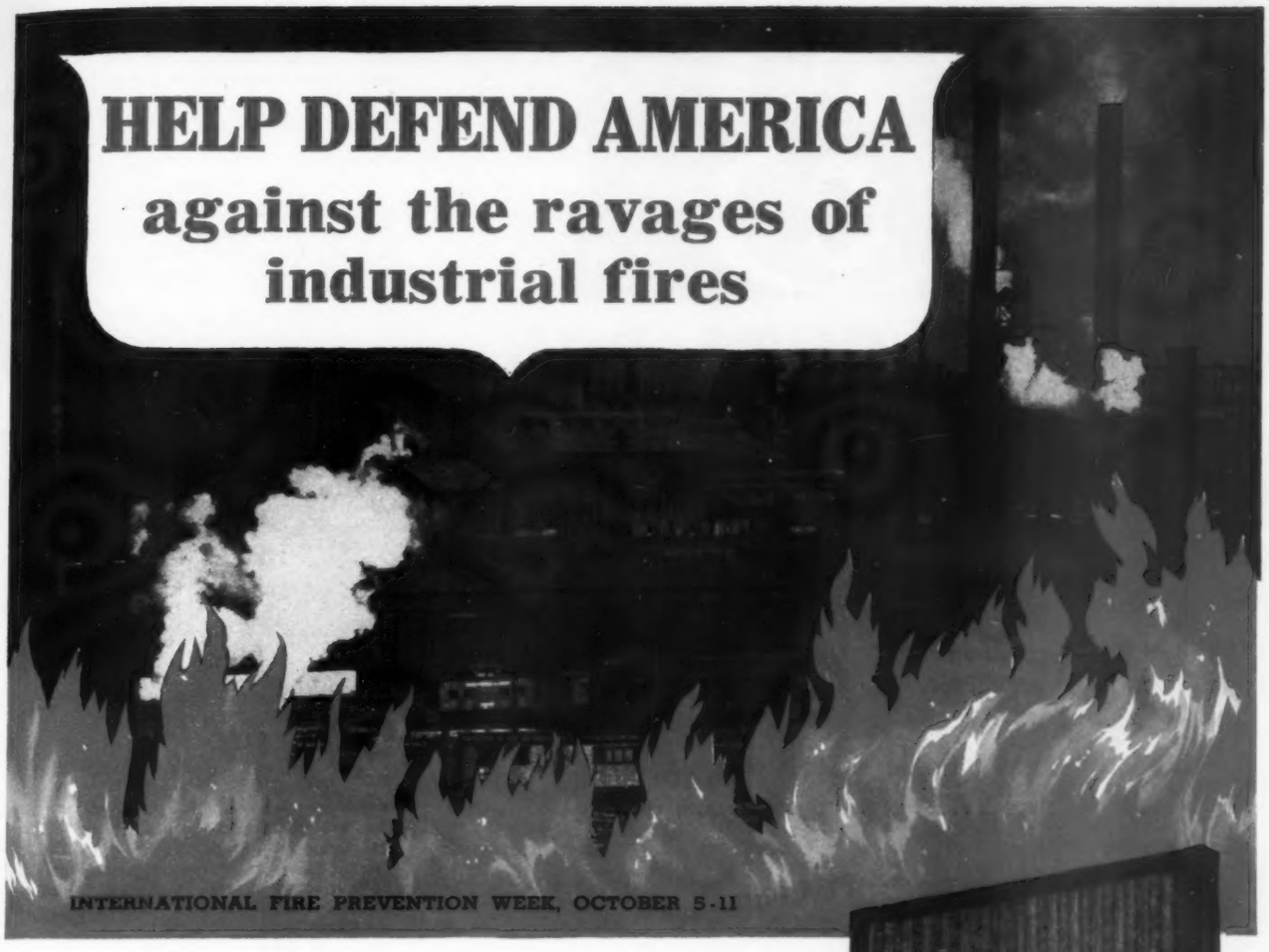
It is often necessary to hold miscellaneous small, round pieces for burring, drilling, or tapping operations. Ordinary pliers are not well adapted for this purpose; at the same time construction of a special



holder would not be warranted, in view of the small number of parts to be handled.

For such odd jobs the simple, hinged holder shown in the sketch will be found very handy and well worth making, because it will find many uses. It can be made from square, cold-rolled steel bar stock.

HELP DEFEND AMERICA
against the ravages of industrial fires



INTERNATIONAL FIRE PREVENTION WEEK, OCTOBER 5-11

R-W AUTOMATIC FIRE DOOR EQUIPMENT is the first line of defense

PROTECTION against the ravages of industrial fires has become a *vital part of national defense.*

Approved R-W Automatic Fire Door Equipment is playing an important part in that defense. This is the equipment that is *sure*—it cannot fail—has saved millions of dollars worth of property.

No fire can get through these heavy corrugated galvanized sheets with the extra protection of sheet-asbestos between. And the automatic closing of the door provided by R-W equipment is absolutely sure . . . a fusible link melts at any set temperature.

Lowers Insurance

No maintenance cost. Guaranteed for 25 years. Buildings so equipped earn substantial reductions in fire insurance rates. The R-W line also includes tinclad Fire Doors, Flush Surface Steel Fire Doors and fire door equipment for any size and all types of doors. Write for catalog today.

1880 • SIXTY-ONE YEARS • 1941

Richards-Wilcox Mfg. Co.

"A HANGER FOR ANY DOOR THAT SLIDES"

AURORA, ILLINOIS, U.S.A.

Branches: New York, Chicago, Boston, Philadelphia, Cleveland, Cincinnati, Washington, D. C., Indianapolis, St. Louis, New Orleans, Des Moines, Minneapolis, Kansas City, Los Angeles, San Francisco, Omaha, Seattle, Detroit, Atlanta, Pittsburgh, Milwaukee, Richards-Wilcox Canadian Co., Ltd., London, Ont., Montreal, Winnipeg

8

SHORT CUTS FOR SEPARATING MIXED STAINLESS STEELS

Stainless Steels are too precious these days to leave lying around, simply because they cannot be identified. But how can you recover a Stainless Steel that has been mixed with carbon steels . . . with other white metals . . . or with other Stainless grades?

To answer these questions, Frasse has published a table of simple, approximating methods for distinguishing the more popular types of Stainless Steels. The new chart tabulates 8 methods—to separate Stainless from carbon steels, chrome-nickel Stainless from moly grades, straight chrome from chrome-nickel grades, etc. A detailed explanation of testing methods is included.

This latest Frasse chart is printed on tough cardboard, regular file-card size. It can be filed, tacked on a wall, or slipped under glass to keep it at your fingertips.

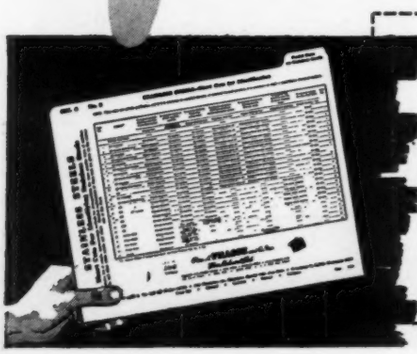
A copy of this handy chart is yours for the asking—but the supply is limited. Why not send the coupon today? . . . *Peter A. Frasse and Co., Inc.: New York, Philadelphia, Buffalo, Jersey City, Hartford, Baltimore, Rochester and Syracuse.*

FRASSE STEELS

Peter A. FRASSE and Co., Inc.

Warehouse Distributors

✓SEAMLESS STEEL TUBING ✓STAINLESS STEELS ✓TOOL STEELS
✓WELDED STEEL TUBING ✓SAE ALLOY STEELS ✓MUSIC WIRE
✓COLD FINISHED BARS ✓DRILL ROD ✓C. R. STRIP AND SHEETS



Peter A. Frasse and Co., Inc.
17 Grand Street, New York, N. Y.

Gentlemen:

Please send me, without obligation, a copy of your latest data chart, Sec. A, No. 3—listing 8 simple methods for distinguishing Stainless Steels.

NAME.....

FIRM.....

ADDRESS.....

BOOKS

ENGINEERING ENCYCLOPEDIA

Edited by Franklin D. Jones. The Industrial Press, 148 Lafayette St., New York. 2 vol. 1431 pages, diagrams. $8.

Condensed encyclopedia and mechanical dictionary giving essential facts about 4,500 engineering subjects. Arranged alphabetically for quick reference.

BETTER FOREMANSHIP

Glenn Gardner, Executive, Forstmann Woolen Co. McGraw-Hill Book Co., 330 W. 42nd St., New York. 336 pages, index. $2.50.

Second edition. Modern industrial management problems as they affect the foreman, presented in practical question-and-answer form. Covers, "New Features in the Relationship Between Foremen and Workers," "New Ways of Handling Old Foremanship Functions," "What Every Foreman Should Know About Today's Economic Situation."

TRANE AIR CONDITIONING MANUAL

Trane Engineering Staff, The Trane Co., LaCrosse, Wis. 376 pages, charts, tables, index. $5.

Second edition, with entirely new chapter on ducts and fans and including the same comprehensive information on air conditioning that was set forth in the first edition. Chapter headings include "Heat," "Comfort," "Heat Gains," "Properties of Air and Psychrometric Chart," "Calculations for the Conditioned Air Supply," "Refrigeration for Air Conditioning," "Water for Air Conditioning." Reference tables and answers to problems also are included.

HOW TO MAKE A MORALE SURVEY

Eugene J. Benge, management engineer, National Foremen's Institute, Inc. Deep River, Conn. 86 pages, loose-leaf, figures, index, bibliography. $7.50.

How to find out what employees are thinking, and apply the knowledge to the best advantage of company and personnel.

THE DESIGN OF MANUFACTURING ENTERPRISES

Walter Rautenstrauch, LL.D., Department of Industrial Engineering, Columbia University. Pitman Publishing Corp., 2 W. 45th St., New York. 298 pages, figures, tables, photographs, charts, index. $3.50.

Methods of manufacturing design are presented through discussions and examples, with tables, charts, and full layouts. The first part of the book deals with business as a whole, the second with selected problems. Examples from process and mechanical industries.

TOP MANAGEMENT ORGANIZATION AND CONTROL

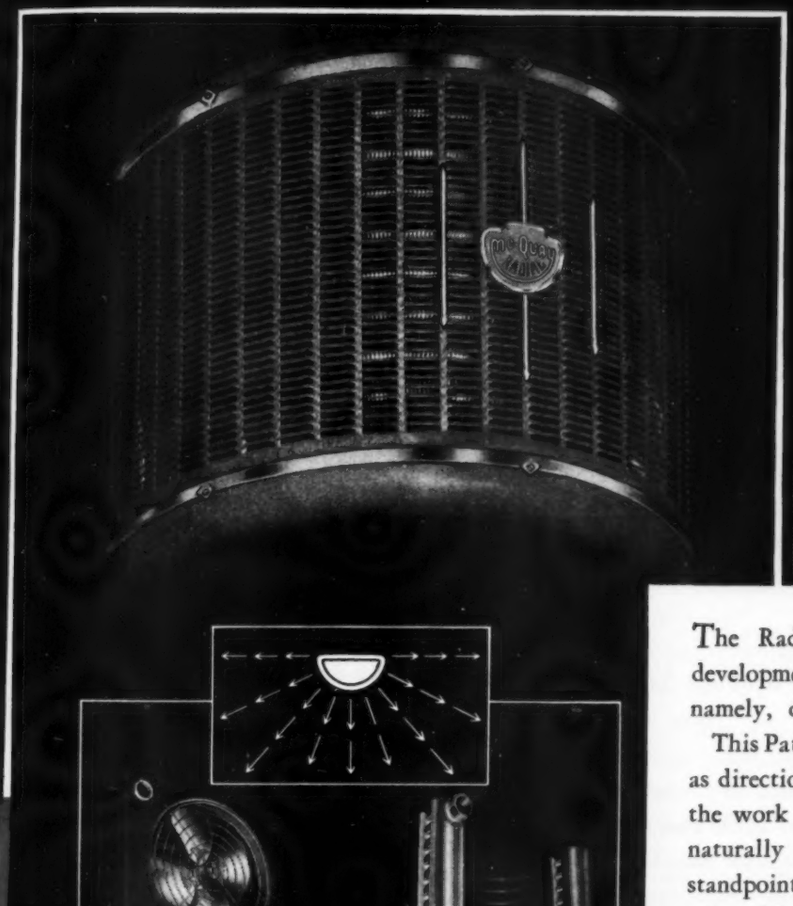
Paul E. Holden, professor of industrial management, Lounsbury S. Fish, research associate, and Hubert L. Smith, research associate, Stanford University. Stanford University Press, Stanford University, Calif. 239 pages, charts, index. $4.

A field study of the organization and functioning of the top management of 31 large companies in building material, chemical, food

McQuay Radial

UNIT HEATER

DOES THE WORK OF TWO OR MORE

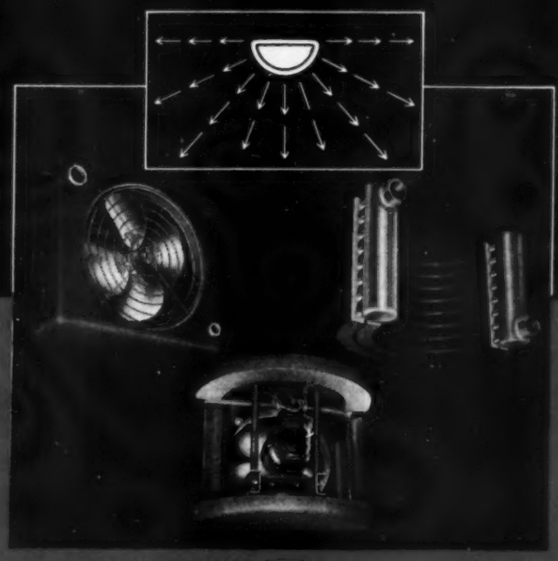


SEMI-CIRCULAR AIR FLOW

HANDSOME APPEARANCE

ECONOMICAL INSTALLATION

EFFICIENT OPERATION



The Radial Unit Heater, an exclusive McQuay development, does what no other unit heater can do—namely, distributes heat over a semi-circular area.

This Patented design, with the fins themselves acting as directional louvers, enables the radial heater to do the work of two or more conventional units. This naturally reduces installation costs, both from the standpoint of labor and material.

In addition to Radial Unit Heaters, McQuay also manufactures the Standard, or horizontal propellor type, the Down Flow, the Gas Fired, the Cabinet, as well as large capacity blower types. All have the traditional and inherent McQuay efficiency, due to the exclusive McQuay coil construction whereby tubes are hydraulically expanded into fins, making a permanent bond without use of solder. Complete engineering data available. McQuay, Inc., 1620 Broadway St., N. E., Minneapolis, Minn. Representatives in principal cities.

McQuay INC.

Air Conditioners . . . Air Conditioning Coils . . . Blast Coils . . . Blower Coolers . . . Comfort Coolers . . . Cabinet Radiation . . . Concealed Radiation . . . Evaporative Condensers . . . Indoor Cooling Towers . . . Ice Cube Makers . . . Ivy-Flo Accumulators . . . Refrigerating Coils . . . Room Coolers . . . Unit Heaters . . . Unit Coolers . . . Water Cooling Units

Prevent Accidents with ANTI-SLIP WALKWAY MESH *of*

Steelcrete

Expanded Metal

ON CATWALKS, skywalks, platforms and stairways use Steelcrete Expanded Metal Walkway Mesh. It is safer not only to walk on but to work on. Tools cannot drop through its small diamond mesh openings. Skywalk mesh is similar to the Walkway Mesh, but has slightly larger openings. Both meshes are available in stock sizes, cut to size or fully fabricated. This stronger, fireproof material is better for many other uses throughout the plant. Steelcrete Expanded Metal can be made up quickly into economical partitions, shelving, window guards, machine guards, pipe tunnel covers and other necessities around your plant. A new 92 page Steelcrete handbook gives full details on this practical expanded metal fabric.

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products, machinery and equipment, nonferrous metals, petroleum products, rubber, and steel, and steel fabricating businesses. Shows how top levels of management function, how policies are formed, authority is delegated, control effected, results are measured, and so on. Part I shows summary and conclusions drawn; Part II explains organization practices; Part III sets forth control practices. An appendix explains the functions and duties of the board of directors.

JOB EVALUATION AND MERIT RATING

Eugene J. Benge, management engineer, National Foremen's Institute, Inc., Deep River, Conn. 73 pages, loose-leaf, charts, figures, index and bibliography. $7.50.

Manual of procedures in evaluating jobs and rating merit of employees. Under the general head of job evaluation are chapters on methods, using the job comparison scale, checking results, and applying the findings. The section on merit rating covers the construction of a rating scale, man-job rating, uses of job rating in transfer and promotion, and how to rate performance.

FINANCING DEFENSE ORDERS

Lynn L. Bollinger, Harvard Graduate School of Business Administration. McGraw-Hill Book Co., 330 West 42nd St., New York. 172 pages, appendices, index. $2.50.

Deals with problems of defense manufacturers in meeting the need for working capital. Emphasis is placed upon explaining the problems and policies of defense authorities, and providing the government official with an understanding of the business man's difficulties. Many cases are cited.

TRAINING WORKERS AND SUPERVISORS

Charles Reitell, Stevenson, Jordan & Harrison, Inc., management engineers. The Ronald Press Co., 15 E. 26th St., New York. 182 pages, figures, tables, charts, index. $1.50.

Designed to help in selecting and training workers. Divided into four parts—selection, training, training for better performance, and training in human relations. List of references.

OCCUPATIONAL HAZARDS AND DIAGNOSTIC SIGNS

Louis I. Dublin, third vice-president and statistician, and Robert J. Vane, supervisor of occupational ratings, Metropolitan Life Insurance Company. Division of Labor Standards, U.S. Dept. of Labor, Washington, D. C. 70 pages. 10c.

Bulletin No. 41, complete revision of bulletin 582, issued in 1933 under the same title. A comprehensive and up-to-date listing of occupational hazards and their symptoms, together with alphabetical list of hazardous occupations.

A SHORT WAR THROUGH AMERICAN INDUSTRIAL SUPERIORITY

Louis Marlio, The Brookings Institution, Washington, D. C. 51 pages, 25c.

Not a documented report based on statistical data, but a personal interpretation, in the light of the author's broad European experience, and first-hand investigation of the American defense program. Chapter headings include: "Why Has Germany Been Victorious Till Now?" "Armament Comparisons," "Con-

HERE'S FLEXIBLE PUMPING POWER

IN ONE TIGHT PACKAGE...

Allis-Chalmers "Electrifugal" Pump Unit LEADS THE FIELD WITH 5 GREAT FEATURES And Cuts Your Costs Up To 33%!

LOOK at the outstanding engineering advancements of this "Tri-Fit" construction . . . its streamlined, compact design! One integrated frame with one precision-made driving shaft means fewer parts, fewer fits, better balance and smoother operation . . .

Even its motor has been specially developed for pump drive — far stronger mechanically and completely splash-proof.

Indestructible rotor and distortionless stator are removable for easy access and quick inspection. Large, sturdy ball bearings . . . splash-proof ventilation . . . cast bronze protective sleeve and cast aluminum fans are just some of the other outstanding features of this modern pump.

Best of all . . . *you can actually cut your initial costs as much as 33% over conventional pump installations.*

For the whole story of the money-saving facts on this "One Package" Pump . . . and how it can help you get *more gallons at less cost* . . . call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis., for Bulletin B-6140.

A 1420

CHECK THESE ALL-OUT ADVANTAGES AND SEE WHY:

1. *Up to 33% Space Saved* with one frame, one solid driving shaft construction.
2. *Overhang Cut As Much As 40%.* Four solid supports assure precision balance . . . ease strain on vital parts.
3. *New "Tri-Fit" Design* eliminates 2 section fits for more positive shaft alignment, wear-less and vibration-free performance.
4. *Splash-Proof Motor* standard equipment . . . 100% designed for pumping.
5. *Easy-to-Get-at Casing* simplifies stuffing box and waterseal gland inspection.

Allis-Chalmers Pumps Can Handle "Anything that Flows"

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MILWAUKEE · WISCONSIN

IN DEFENSE OF DEFENSE

Production! A vital factor in today's mad scramble for defense . . . whether in the factory, the shipyard or ordnance plant . . . depends on *uninterrupted* schedules. Waste of man-hours now is inconceivable! Your assembly lines—*anybody's*—are no better than the casters used to keep them rolling. That's where Faultless Casters play *their* part in the defense of defense—preventing waste of time, keeping the wheels of production turning at capacity. Examine Faultless No. 200 Heavy Duty Truck Caster illustrated and you can't help but be impressed with its sound design, its workmanship, its all-around excellence. Sold by leading distributors everywhere.

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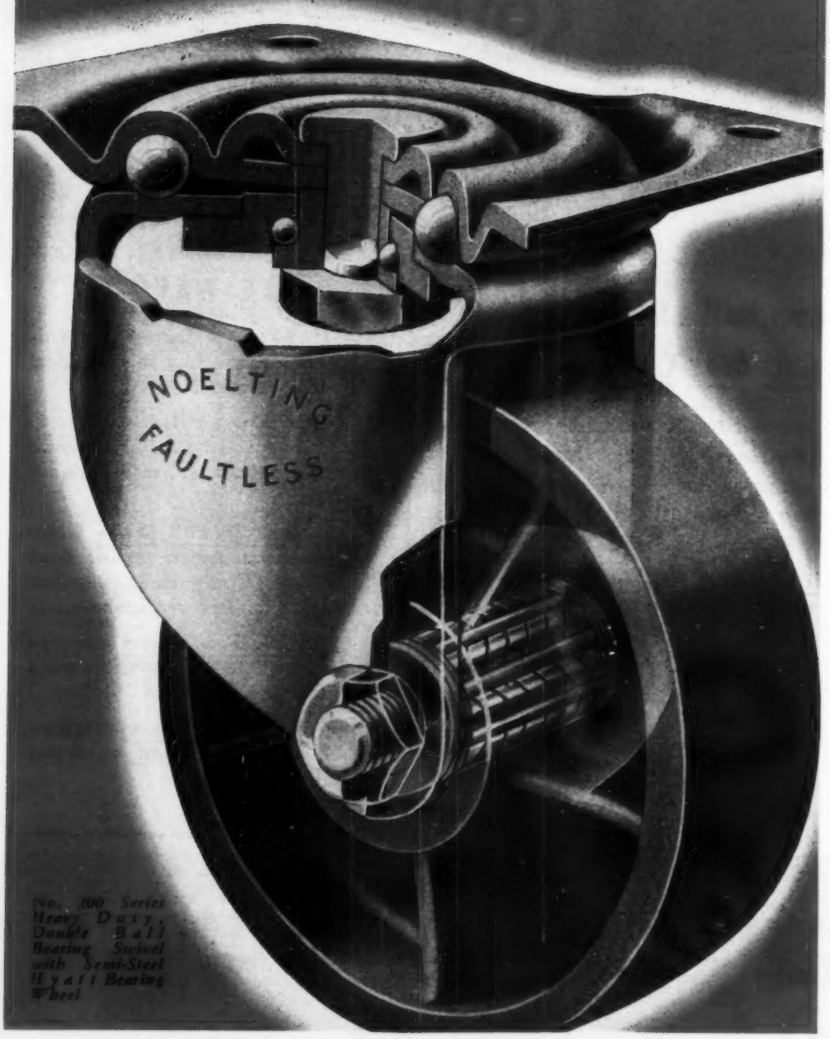

No. 200 Series Heavy Duty Double Ball Bearing Swivel with Semi-Steel Hyatt Bearing Wheel

trolling Factors in Armament Production in the United States and Germany," "How Can the United States Attain Quickly a Vast Increase in Armaments?" and so on.

THE ENGINEERING INDEX, 1940

Engineering Index, Inc., 29 W. 39th St., New York. $50. 56th Annual Edition. Contains 26,000 annotations of articles that have appeared in domestic and foreign technical periodicals, 40,000 cross references, and authors' and contributors' index of 19,000 names. All engineering branches are included.

•

ON THE CALENDAR

SEPTEMBER

17–19, National Industrial Advertisers Association, Toronto. Miss M. R. Webster, Secretary, 100 East Ohio St., Chicago.

23–25, Illuminating Engineering Society, 35th Convention, Atlanta. Frank G. Horton, Executive Secretary, 51 Madison Ave., New York.

23–26, Association of Iron and Steel Engineers, Annual Meeting and Exhibit, Cleveland. Brent Wiley, Managing Director, 1010 Empire Building, Pittsburgh.

29–Oct. 3, National Recreation Association, 26th Congress, Baltimore. T. E. Rivers, Secretary, 315 Fourth Ave., New York.

OCTOBER

6–8, National Electrical Contractors Association, Annual Meeting, Houston, Texas. Laurence W. Davis, Secretary, 420 Lexington Ave., New York.

6–10, National Safety Council, Annual Meeting, Chicago. W. H. Cameron, Managing Director and Secretary, 20 North Wacker Drive, Chicago.

6–11, Chicago Exposition of Power and Mechanical Engineering, Quadrennial Meeting, Chicago. Charles F. Roth, Manager, Grand Central Palace, New York.

12–15, American Society of Mechanical Engineers, Fall Meeting, Louisville, Ky. Ernest Hartford, Executive Assistant Secretary, 29 West 39th St., New York.

19–24, American Welding Society, National Metal Exposition, Annual Meeting, Philadelphia. Miss M. M. Kelly, Secretary, 33 West 39th St., New York.

20–24, American Gas Association, Annual Meeting, Atlantic City. Kurwin R. Boyes, Secretary, 420 Lexington Ave., New York.

NOVEMBER

19–20, American Management Association, Production Division, Pittsburgh. H. J. Howlett, Secretary, 330 West 42nd St., New York.

28–29, American Leather Belting Association, Annual Meeting, Atlanta. E. R. Rath, Executive Manager, 53 Park Row, New York.

"INSTALL MACHINERY WITHOUT BOLTS? —never heard of it!"

But—figure it out for yourself.

• The above machine was installed on two strips of Unisorb Cushion Machine Mountings which eliminated the necessity of bolting it down. If at any time the machine has to be moved again, it can be moved quickly without leaving unsightly holes in the floor at its old location.

1. Saves up to half the usual time.
2. Saves up to 50% of the cost.
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6. Saves everywhere and every time you move a machine.

So...why not ask for Unisorb Cushion Machine Mountings the next time you have an installation or relocation problem.

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FELTERS FELT FUNCTIONS

"In years of service, whenever a more snug fit of shaft is required, it is merely necessary to remove plate and *peel* off the shim laminations." So testify the manufacturers of this tool room engine lathe. Shafts in the gear box assembly must be loose enough to avoid hot shafts ...tight enough to insure proper gear meshing. LAMINUM turns the trick. • *Shims (.002 or .003 in. thick laminations) cut to order at our factory. Stock shim materials for repair or maintenance work, obtainable from mill supply distributors.*

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54 Union St. Glenbrook, Conn.

Write for file-folder of shim application photos—and Laminum sample.

LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT
1665

THEY SAY AND DO

400 Dollar-a-Year Men Aid Safety Drive

Industry's great fight against on-the-job accidents is speeding up under the impetus of defense. The rise in industrial production means a corresponding increase in the total of mishaps. Plus this, the percentage of accidents to man-hours worked is being driven upward by the influx of new, quickly trained workers in plants where even the seasoned employees are tackling unfamiliar operations.

All of which means overtime for industry's hard-working corps of safety engineers. Yet many of them are among the 400 specialists who are giving freely of their services as "dollar-a-year" volunteers in the field work of the National Committee for the Conservation of Manpower in Defense Industries.

This government-created agency seeks especially to reach the many smaller plants that are now going into defense subcontracting. The services as consultants of the staff of 400, which includes plant safety specialists, state safety officials, and labor representatives, are offered without charge to all industrial plants.

With a recent Congressional grant of $200,000 the committee plans to add a number of full-time safety engineers to its staff. It will also begin 25-week training courses in certain engineering schools for picked plant employees who want to learn the fundamentals of good safety practice. Requests for further information may be addressed to V. A. Zimmer, director, the National Committee for the Conservation of Manpower in Defense Industries, Division of Labor Standards, Department of Labor, Washington, D. C.

•

Alien Ban, "Cool Off" Period Urged in Labor Bill

The Boren-Disney Bill, now before the House of Representatives, has a much longer title but it might well be called "a bill to end abuses of labor's rights."

Introduced as an amendment to the National Labor Relations Act, this bill would deprive labor unions of their status and protection under the Act if any officer thereof: (a) is not a citizen of the United States, (b) has not been engaged in the occupation represented by the union for at least three years, and (c) is not adequately bonded for the safekeeping of the union's funds.

Moreover the bill would require the officers of unions to render annual financial statements to the members. It further would effectively prohibit jurisdictional strikes by providing that all unions must submit such disputes to arbitration.

Finally, the bill establishes a 60-day "cooling off" period in all strikes by stating that unions cannot keep their status unless their constitutions and bylaws "bind the members thereof to postpone strikes in connection with any labor disputes for at least 60 days upon securing agreements that settlements of such disputes will be made retroactive to the date the dispute arose."

This bill is the direct result of a labor resolution, adopted at the annual convention of the Railroad Yardmasters of North America Inc. in Buffalo, last spring. The substance of the resolution was translated into the bill and introduced by Representatives Lyle H. Boren and Wesley E. Disney, both Oklahoma Democrats.

Hopeful of its chance of passage is Maurice R. Franks, national business agent of the Yardmasters and editor of *The Railroad Workers Journal*. It is, he says, "the only bill of its kind pending in Washington that has not received the wrath of Capitol Hill." Franks declares that a favorable public reaction has greeted the measure and that this reaction "comes almost exclusively from the rank and file of organized labor."

•

New Trade School Speeds Training With Films

One, two, and three-month quick courses in machine tool operation, stressing contour machining and surface grinding, are being given without charge in a new Minneapolis training school. Enrollment includes beginners and experienced men.

The courses, of from 200 to 500 hours of shopwork, are supplemented by a 10-reel industrial sound film which covers the study of chip production, die, jig, and fixture making, and basic information about machine tools. Lecture periods are also held on blueprint reading, layout methods, and metallography.

Trainees are selected locally and also from industrial plants throughout the country. Known as the Doall Trade School, the new venture is sponsored by Continental Machines Inc.

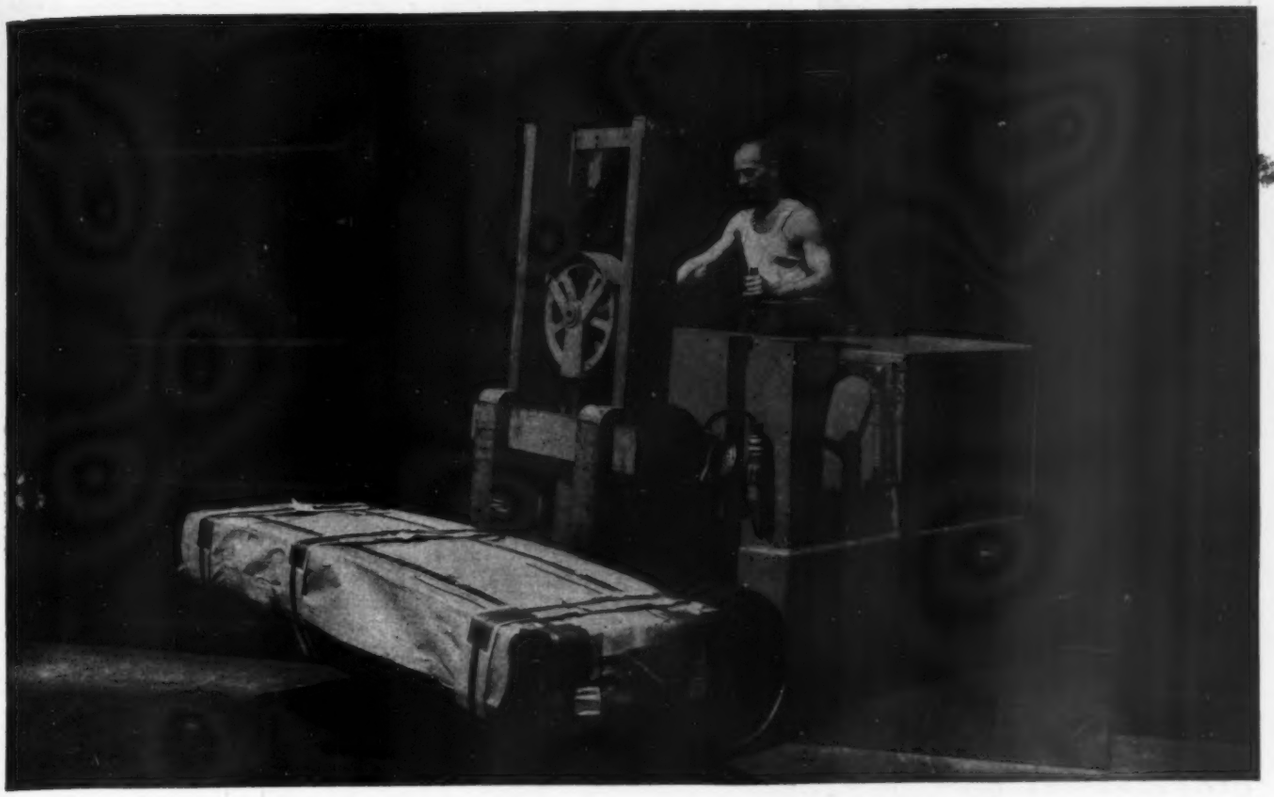
•

Hygiene Group Seeks to Cut Billion Man-Hour Loss

Estimating that 1,000,000,000 man-hours are lost due to employee illness in the heavy industries yearly, the Industrial Hygiene Foundation of America, Inc., is launching a renewed drive to combat sickness's inroads on defense production.

With a new slogan, "Defend the Defense Workers!" and a new name (the group was formerly known as the Air Hygiene Foundation of America) this Pittsburgh organization is collaborating with the United States Public Health Service in a study aimed to reduce illness and occupational health hazards.

Besides its researches in control of toxic fumes and gases and its study of im-



IT'S A HARD WORKER!

A battery industrial truck works anywhere from 8 to 24 hours a day and from 250 to 300 days a year.

Judged by almost any standard, it makes a remarkable record of day-in-and-day-out dependability, freedom from trouble, long life and economy.

It will put in about six times more service hours per year than the average automobile, yet be in the shop less. It even outdoes a steam railroad locomotive in availability for service.

For example, in 24-hour-a-day service, the storage batteries work in relays, one being charged and flushed while the other is powering the truck. Except for two or three minutes needed to exchange batteries (at intervals of 8 to 12 hours) the truck does not need to stop work for servicing of its power unit.

This helps explain why ***battery*** industrial trucks are first choice in industries that must have continuous operation 24 hours a day, day after day, year after year. They are first choice, too, in industries that know, and watch, operating costs. They use low-cost electric power, and their entire operating mechanism is inherently simple and trouble-free.

They are extra dependable and extra economical when powered by Edison Alkaline Storage Batteries. With ***all-steel*** cell construction, a solution that is a natural preservative of ***steel,*** and plates in which all active materials are retained by perforated ***steel*** tubes and pockets, they are the most durable, lightest, most trouble-free of all storage batteries.

Alkaline batteries provide ample power for the largest trucks yet built, for trucks operating within limited clearances, and for any daily schedule up to 24 hours.

For more detailed information send for our bulletin MODERN MATERIAL HANDLING. New edition, just off the press, describes the various industrial-truck handling systems; illustrates the latest methods; gives detailed data on alkaline batteries. Edison Storage Battery Division of Thomas A. Edison, Inc., West Orange, New Jersey, U. S. A.

Edison
STEEL *Alkaline* **BATTERIES**

GROUP WASH FIXTURES SAVE SPACE

★ SAVE INSTALLATION TIME . . .
PROVIDE MAXIMUM SANITATION

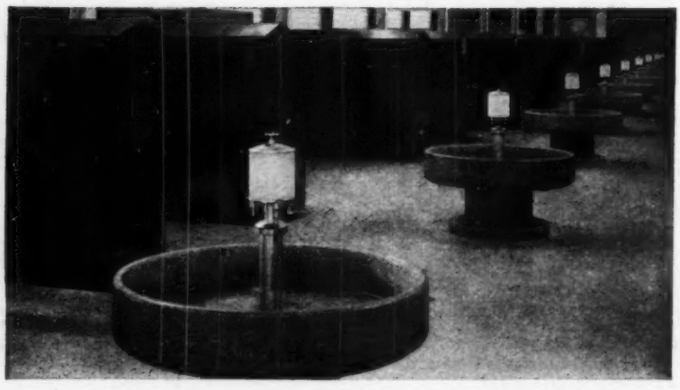
• There has never been a time when the washing facilities for employees were being given as much consideration as they are now. Nor is there a country in the world that provides as modern, sanitary wash fixtures as are found in the plants of the U.S.A.

These fixtures, Bradley Washfountains, each accommodate 8 to 10 persons simultaneously with clean, running water from the central sprayhead. Compared to individual wash basins for the same number of persons, the number of piping connections is reduced by 80 to 90 per cent, saving installation and maintenance expense.

Washroom Plan Booklet

To assist in modernizing washrooms or planning washrooms for new buildings, Bradley Washroom Consultants are ready to make suggestions — and a copy of our booklet "Washroom Layouts" will be forwarded on request. BRADLEY WASHFOUNTAIN CO., 2215 W. Michigan Street, Milwaukee, Wisconsin.

BRADLEY
WASHFOUNTAINS



Bradley Washfountains in locker - shower room in new Foundry Employees' Service Building, Caterpillar Tractor Co., Peoria, Ill. Designed by Richard Belsterling and built by Fred Harbers' Sons, Contractor.

proved X-ray techniques for large-scale physical examinations, the Foundation is doing notable work on exhaust ventilation and precautions in welding. It is currently advancing new investigations in "protector" dusts, including aluminum, to combat dust diseases.

In addition to its laboratory work, the Foundation publishes a digest to keep its members posted on progress in the industrial hygiene field. About 300 journals, published in 12 languages, are reviewed. The sixth annual meeting of the Foundation will be held at the Mellon Institute in Pittsburgh on November 12 and 13.

•

Defense Agencies Seeking Industrial Specialists

Uncle Sam is the beneficiary of millions of dollars worth of executive ability, on loan from industry in the form of dollar-a-year men. However, a serious shortage of middle-bracket brainpower has set in at Washington and the call has gone out for more and more industrial specialists to work full-time for the government at medium salary levels.

The rapidly expanding staffs of the Office of Production Management and the Office of Price Administration and Civilian Supply will, between them, offer hundreds of vacancies to men who have special technical and practical knowledge of certain industries. Their help is needed, on the production side, as expediters, negotiators, and inspectors. In the OPACS picture there is great need for men who can handle both the research and the diplomacy required for the administration of allocations.

Both OPM's William S. Knudsen and OPACS' Leon Henderson say they do not want to deprive defense industries of key men. Instead they are hopeful of getting the help they need from men now engaged in posts of secondary importance to defense. Civil service examinations will be used to select applicants. Salaries will range from $2,600 to $6,500 a year.

•

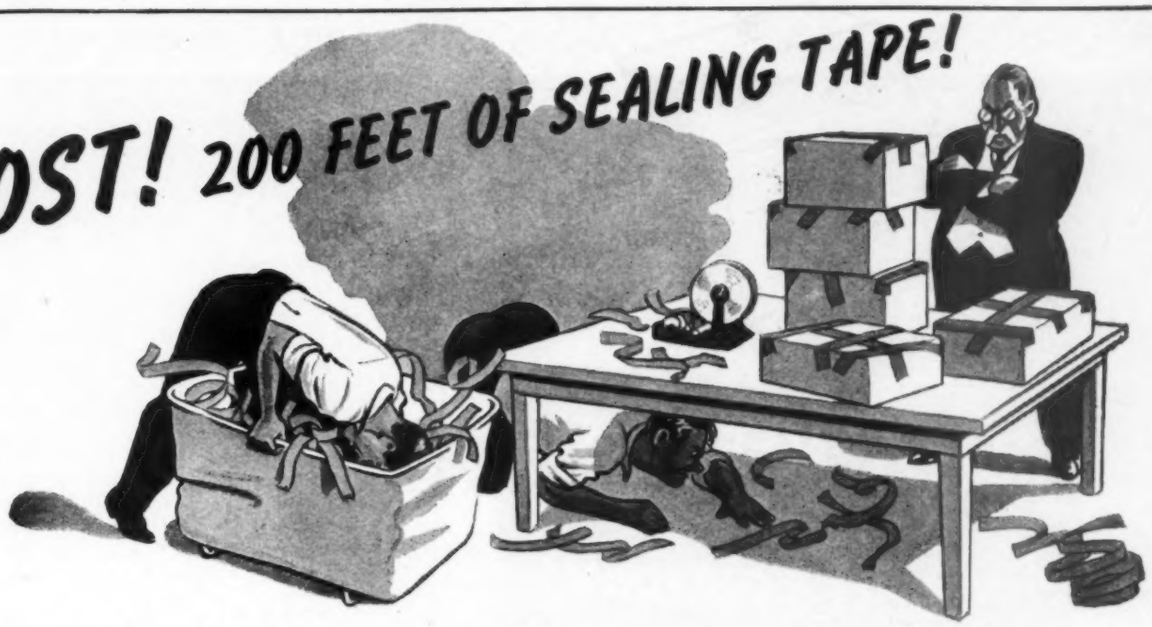
Industrial Truck Bookings Close to June Level

With 273 units recorded, July bookings of electric industrial trucks remained close to the high levels of June and May, according to reports of the industrial Truck Statistical Association of Chicago.

The total net value of chassis only during July was $1,059,093, showing an increase of $111,088 over the June figure. The booking of 273 units, however, was slightly below June's total of 287.

The July bookings included: 15 non-elevating platform trucks of 1,000 to 6,000 pounds capacity at base chassis prices from $1,100 to $3,295 and with a total net value of $39,670; 273 cantilever trucks, capacity 1,000 to 20,000 pounds, price $2,085 to $13,010, total net value $791,855; 11 light and heavy duty tractors, price $1,300 to $2,025, total net

LOST! 200 FEET OF SEALING TAPE!



— that's what's lost out of *every* 600 ft. roll in many shipping rooms. Think of it! One-third of every roll gone in wasted cutting — wrong guesses on lengths — uneven wetting — jamming in the machine — resealing. Think of the loss — in dollars — in time!

Nashua's National Tay-Per ends all this loss — stops your tape wastage — saves your time. That is why many a Shipping Department head is making a hit with the "big boss" by getting a Tay-Per. It will pay for itself in time and tape saved often in a few weeks. And it's as good as an "extra man" in your Shipping Room.

Look At These Features!

Saves time... Saves tape... Always ready ...Does neater job... Won't jam... Cuts cleanly... Delivers tape in proper lengths ... Cutting 2 different standard lengths by simple lever shift... Moistens labels too... Extra large water supply... AND

New POSITIVE Automatic Moistening Control...

Eliminates imperfect sealing due to uneven moistening. All guesswork ended — 3 *positive* water levels insure proper moistening.

Many other exclusive features.

HIGHEST QUALITY CONSTRUCTION FOR BETTER SEALING WITH LESS TAPE, GET A TAY-PER

Nashua's National TAY-PER

Model 52

CREATORS • CHEMISTS • CRAFTSMEN
NASHUA
MAKES PAPER MAKE MONEY FOR YOU

"NO WASTE — NO DAMAGE — BUT SAVING PLUS SECURITY" is a booklet giving full facts on Nashua's streamlined National TAY-PER and ITSTIX Tape. Send coupon for free booklet, today.

NASHUA PACKAGE SEALING CO.
Dept. F-9, Nashua, N. H.

Please send free booklet on TAY-PER

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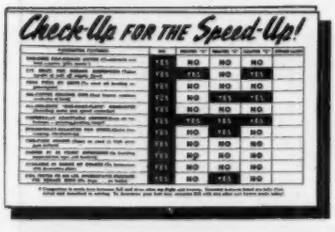
Wah-h! He's a weak "sisster." He just can't take the terrific punishment of 3-shifts-a-day. When you try to pack *3* years of hard wearing life into one year — he makes a *big noise* about it — causes you a lot of trouble. He may even quit *cold!*

ILG UNIT HEATERS ARE "TOUGHIES"

They're real "he-man" heaters — the kind that far-sighted, shrewd-operating management has been buying for 25 years. The kind that takes *3*-shifts-a-day without blinking. Sure! . . . ILG Unit Heaters* stand up under the speed-up. Check up and see why!

* With EXCLUSIVE self-cooled motor that "breathes" . . . two-piece header . . . all-inclusive "ONE-NAME-PLATE" guarantee!

THIS IS HOW YOU GET ALL THE FACTS



Spread this "check chart" out on your desk and actually *see why* ILG is your best buy! This chart is part of ILG's brand new catalog and engineering data book. Write or phone for FREE copy today. Get *all* the facts — then decide!

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ILG *Vital Zone* ★
UNIT HEATERS
★ HEAT THE *Vital Zone* WHERE PEOPLE WORK AND PLAY

value $17,515; 41 Crane trucks, capacity 500 to 6,000 pounds, price $1,400 to $8,150, total net value $206,096; one special truck with capacity of 2,000 pounds and total net value of $3,960.

Net values are reckoned at factories after adjustment for variations from standard specifications, trade-in allowances, and so forth. The July totals were arrived at after adjusment for cancellations of April bookings, one for May and two for June.

•

Defense Bond Sales Spurred by Contribution

To encourage the purchase of Defense Savings Bonds, a Chicago employer has offered to pay the first dollar toward the purchase of the first bond bought by each employee.

Sponsor of a 30-year-old Employees Thrift Club, the Kellogg Switchboard and Supply Company took this new step to stimulate savings by offering to open United States Defense Bond Accounts for employees and to make regular deductions for deposit, if so desired. Recommending Defense Bonds as an investment, Maurice K. McGrath, president, announced that the company would open each such account with the $1 credit.

•

Hillman Urges Employment and Training of Women

The aircraft industry will presumably become the first large-scale trainer and employer of women "war workers." Sidney Hillman, OPM labor chief, has urged aircraft employers to hire and train women to avoid unnecessary importations of labor to already crowded communities.

An OPM survey has found women competent to work in such operations as bench and stainless steel assemblies, painting, covering, heat-treating, anodizing, welding, and final assembly. Hillman, in a letter to 75 aircraft companies and 90 other companies making a variety of defense products, promised that OPM training facilities would establish courses for women to encourage their employment. Hillman warned, however, that "hours of work, rates of pay, and conditions of work should conform with established standards for the industry in order that there may be no disturbance due to a lowering of these standards."

•

Second Defense Clinic Announced in New York

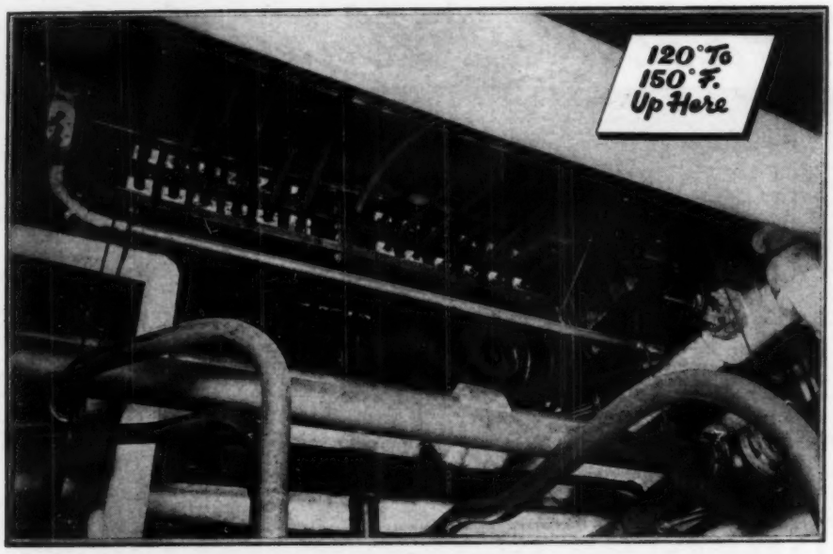
A three-day defense clinic (similar to the one described in the current *Factory* article, "From Butter to Guns," starting on page 50) will be held at New York's Grand Central Palace beginning September 20.

Sponsor is the Defense Contract Service of OPM. Prospective subcontractors throughout the East are urged by W. O. Crabtree, DCS district manager, to send

Insulation Facts · Number 4.

EHRET'S 85% MAGNESIA IS BOTH LIGHT AND STRONG
Like the strands of a spider web, Ehret's 85% Magnesia has adequate strength with a minimum of weight. Shipping abuse, service vibration and the accidental blows, shocks and jars to which insulated piping and equipment are so frequently subjected, mean little to Ehret's 85% Magnesia. The light weight of this highly efficient insulation imposes no penalty in the form of unwarranted breakage or structural failure.
In addition to 85% Magnesia, the Ehret Company provides a full line of industrial insulations. It will pay you to consult your Ehret Contractor or Distributor on insulation problems and requirements.
EHRET MAGNESIA MANUFACTURING CO.
VALLEY FORGE · PENNSYLVANIA
SAVE HEAT WITH EHRET INSULATIONS

MAKERS OF INDUSTRIAL INSULATIONS FOR MORE THAN 40 YEARS



STEAM LINES + WIRING = T-R-O-U-B-L-E!

Here's a nest of potential wire failures cooking up future trouble in the insulation-destroying heat of 120° to 150° F. — vital power, control and lighting circuits that are bringing shutdowns and lost production closer every day *because their insulation can't take heat!*

In an installation like this, where circuits had to be run between the steam lines and ceiling, continuous high ambient temperatures combine with conductor heating caused by production overloads to ruin anything but *genuinely heatproof, permanent insulation.* Under such heat, insulation having low temperature operating limits begins to go as soon as it is installed. It dries out, gets brittle, cracks; then moisture enters and you have a rewiring job that may tie your plant in knots.

1. Rockbestos A.V.C. Boiler Room and Lighting Wire
2. Rockbestos A.V.C. Power Cable
3. Rockbestos All-Asbestos Power and Rheostat Cable

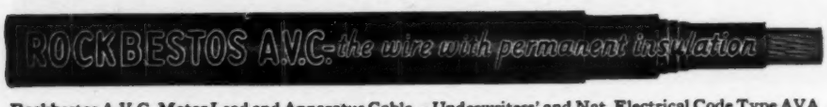
Numbers 1 and 2, Underwriters' and N. E. Code — Type AVA, max. operating temperature 230°F., number 3, Type AI, max. operating temperature 257°F.

Another horrible example we saw a few months ago was in a steam tunnel running from a factory power plant to the shops. It was jammed with steam lines, watchman, telephone and fire alarm systems, along with 13 – No. 1/0 AC lighting circuits, 16 – 500,000CM DC power circuits and 22 – 500,000CM low voltage AC power circuits. Temperatures of 110° to 130° F. had dried them out so badly that an arc would have burned the tinder-dry insulation and crippled operations. It could have been rewired weekends with *heatproof, fireproof, permanently insulated* Rockbestos, but they were "too busy" — now they're working full time and are hoping that it won't blow.

These two examples illustrate the need for *permanent insulation* wherever wire is exposed to severe operating conditions and the necessity for anticipating your requirements. Send for a catalog and samples. Rockbestos Products Corporation, 812 Nicoll St., New Haven, Conn.

Anticipate Your Requirements!

New York Buffalo Cleveland Detroit Chicago
Pittsburgh St. Louis Los Angeles San Francisco Portland, Ore. Seattle



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registrations in advance to the Defense Contract Service, 33 Liberty Street, New York, N. Y. Admission will be by ticket, sent out following registration.

Manufacturers are asked also to send details about their facilities (make, size, age, number, and working tolerances of machines and availability of skilled labor) to enable DCS engineers to analyze facilities in advance of the meeting.

•

Plainer Cars Forecast; Plastic Model Shown

History-making problems confront America's motor-makers, the leaders of the great key industry that once pushed the nation far down the road to prosperity and later helped to pull it out of a depression. Now, amid far-reaching, unprecedented changes, the policies of the automotive industry are being watched with greater public interest than ever.

The war's first big effect has already been felt: The final agreement of OPM and OPACS spells a drastic curtailment in the total of passenger cars to be produced during the coming year (although truck production will, if anything, exceed previous levels). Nothing like a permanent shutdown will hit the passenger car plants, however, for they are already obligated to $2,000,000,000 worth of defense work and they probably will be asked to take on at least $2,000,000,000 more.

Meanwhile it looks as though a heavy volume of consumer purchasing power will quickly absorb all the new cars that the industry can put on the market. The factories' problem, therefore, is one of producing as many cars as possible with the available materials and facilities. Having already done a great deal to reduce its use of critical materials, the industry will do still more. Next year's cars will contain even less nickel, chrome, and aluminum. Brass radiators will probably replace copper ones. Aluminum pistons will be eliminated and the aluminum content of fender steel will be greatly reduced.

The eventual course of the trend toward plainer cars may be discerned in Canada which last year "froze" new car models (as well as refrigerators, radios, vacuum cleaners, and anything else in which a change of design might entail new tooling). Going one step further, Canada will this year reduce from 147 to 79 the various types of passenger car offered to the public. The choice of colors, upholstery, and accessories will also be limited.

For the future, Canadian manufacturers are considering the adoption of lighter, cheaper, much simpler designs—primarily utilitarian—that will hold the industry's consumption of materials and the individual's consumption of gasoline, oil, and rubber to a minimum. Many Canadian observers are sure this will occur if the war stretches over the years.

Of special interest, therefore, was the unveiling of Henry Ford's first plastic automobile not long ago in ceremonies at the Ford Motor Company plant in Dearborn, Michigan. This car's pressed plastic body weighs 2,000 pounds by con-

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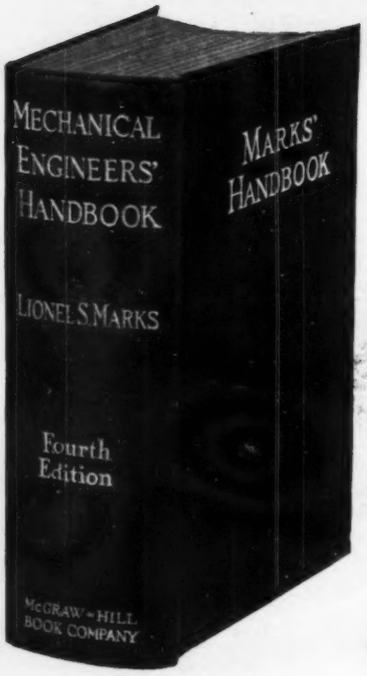

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trast with the 3,000-pound steel bodies now in use.

Although the new car seemed coincidentally appropriate to the war situation, it was not so planned. It was, instead, the result of no less than 12 years of diligent research begun at a time when war seemed remote, if not impossible. Its original aim, in fact, was to provide a means by which the products of agriculture could be used in industry.

In a brick-and-wood three-story laboratory in Dearborn in 1929, Robert A. Boyer and 28 other young scientists set up shop under Mr. Ford's direction with general instructions from the motor manufacturer to devise new ways of using agricultural products in industry. Boyer, then only 20, was the eldest of the lot.

During their 12 years' work, the eager young experimenters developed a number of remarkable new plastics, culminating their quest with the new body, which is superior to steel in everything but tensile strength.

To demonstrate its merit, Mr. Ford himself took an axe and struck a sharp blow upon the plastic panel. The axe bounced off harmlessly and the panel was undamaged. Mr. Ford then brought the axe down upon a steel panel and the blade bit into the metal easily.

Chemist Boyer explained the degree to which the plastic car would achieve its original aim.

"If we made a million automobiles a year with plastic bodies," he said, "we would consume at least 170,000 tons of agricultural products and 50,000 tons of synthetic chemicals, including 100,000 bales of cotton, 500,000 bushels of wheat, 700,000 bushels of soybeans, and 500,000 bushels of corn."

•

$218,000 Payoff Recorded in Profit Sharing Plan

When Fairbanks, Morse & Company, Chicago, announced the distribution to employees of approximately $218,000 in the form of profit-sharing checks, this amount was not picked blindly out of thin air, as being a nice round figure. Both the profit-sharing idea and the amount to be distributed were results of a well-prepared plan, presented to employees in booklet form in January, 1940.

Under this plan the company establishes a "bonus fund" and credits to it a specified amount—arrived at by deducting the capital earnings from the net profit of the company. Of the balance of net profit remaining, 15 percent of the first $500,000, 20 percent of the second $500,000, and 25 percent of any remaining balance is credited to the fund.

"Capital earnings" are defined as 7 percent of (1) the average stated value of the common and preferred stock, and (2) the surplus accounts as of December 31 of the preceding year.

"Net profit" is used to mean the final net profit of the company and its subsidiaries after payment or provision for all expenses, reserves, taxes, and all other charges.

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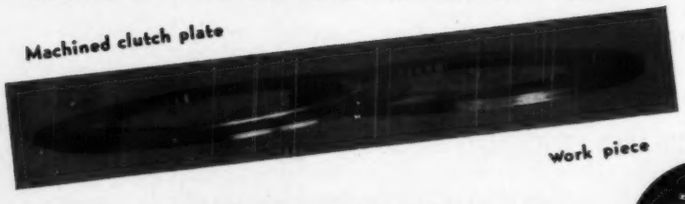

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his earnings for the year, and is the same percentage of his earnings as the percentage of the total amount of the fund is to the annual earnings of all employees.

If the total fund should fall below 1 percent of the total employee earnings, no bonus would be paid. Amount in the fund would be carried forward until the accumulated annual credits permitted a distribution of at least 1 percent.

Both hourly paid and salaried employees are eligible but they must be in the employ of the company when distribution is made, and must have been in continuous service since the first day of the year preceding the date of distribution. No employee who worked under a plan of compensation that provided commission, bonus, or other extra compensation is eligible to receive any part of the profit-sharing bonus—except factory shopmen who are on piecework, bonus, or other incentive plan. Employees who have been partly on commission and partly on straight salary receive bonus on their salaries only.

•

Industrial "Bill of Rights" Asked by N. A. M.

One of the sharpest criticisms of government labor policy that has lately been issued was evoked by the Federal Shipyard strike at Kearny, New Jersey, and came from the National Association of Manufacturers.

Citing the loss of 4,400,000 man-days of defense work in the first seven months of 1941, the N.A.M. declared that such losses would continue under the government's present "inadequate" labor policies. Many walkouts have not been the result of disputes over wages and hours but represent instead, the Association declared, "attempts of labor unions to gain more power in the absence of a law which would grant both workmen and management equal responsibilities as well as rights."

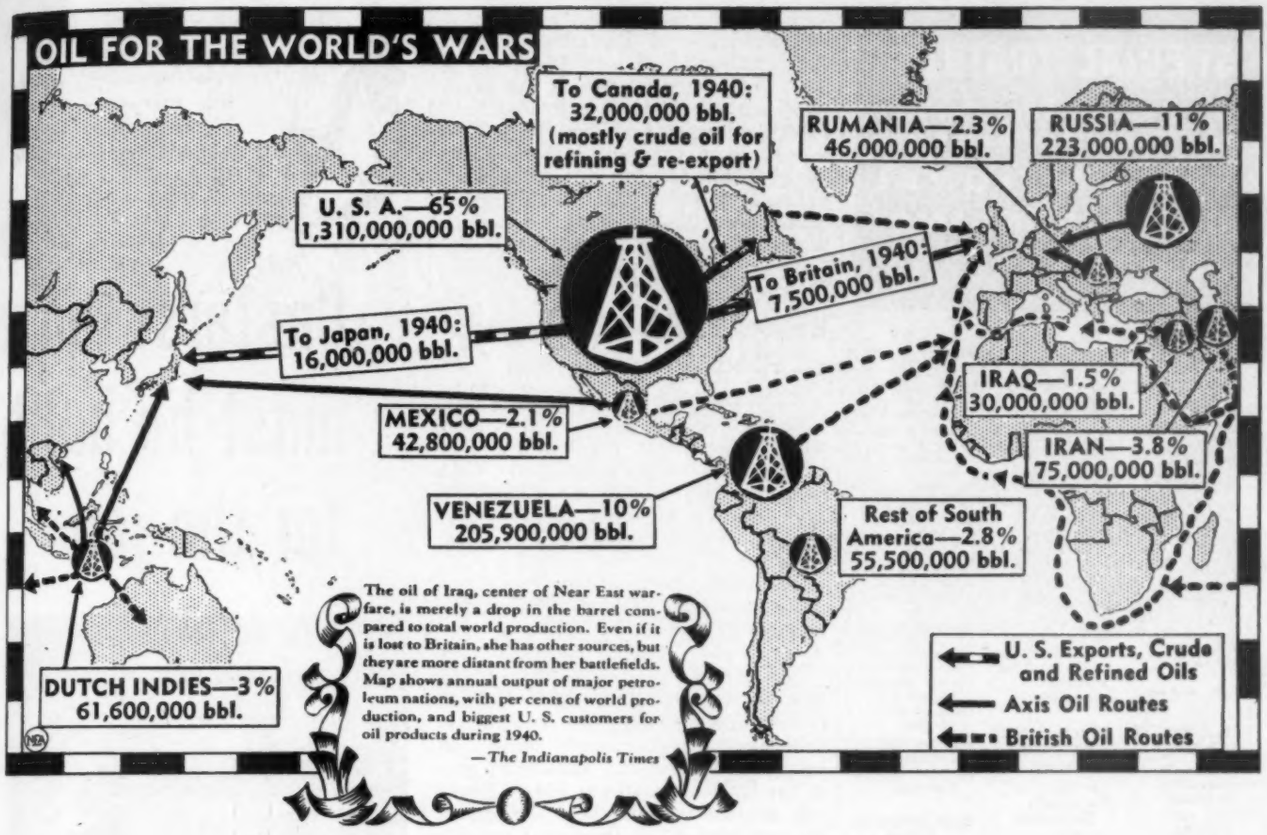
The Association then called for a "new bill of rights for American industry, workmen and management" that would require that "the responsibilities of labor be as firmly established under law as are those of management."

"If the government of this country seeks to preserve fundamental American principles, it cannot tolerate a national labor policy which will permit the continuance of tremendous losses of vital defense production because of labor union irresponsibility and demand that every worker belong to a union to work for national defense," the N.A.M. statement asserted.

The statement pointed out that the Kearny shipyard strike was called in violation of a two-year agreement under which the employees had gained a 12 percent wage increase and that the aim of the strike was to secure a closed shop.

Almost at the same time, A. W. Hawkes, president of the Chamber of Commerce of the United States issued a statement severely condemning the closed shop and appealing to labor leaders to abandon it as an objective.

"The closed shop or any equivalent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To Japan, 1940: 16,000,000 bbl.
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The oil of Iraq, center of Near East warfare, is merely a drop in the barrel compared to total world production. Even if it is lost to Britain, she has other sources, but they are more distant from her battlefields. Map shows annual output of major petroleum nations, with per cents of world production, and biggest U. S. customers for oil products during 1940.
—The Indianapolis Times

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thereof is un-American and monopolistic and interferes with the individual freedom granted to all our people under the Constitution," Hawkes declared. "Any man should be able to work lawfully when, where, and how he pleases; and any man, company, or corporation, should be able to hire anyone to work in a lawful pursuit. This should be so whether the individual belongs, or does not belong, to any lawful union."

•

Byrd Attacks Concealment of Production Figures

No matter what else he settled, Senator Harry F. Byrd, Virginia Democrat, drew attention to one of the most unsettled points in government defense policy when recently he issued a statement charging the Administration with concealing data on what he called a serious lag in industrial output for defence.

Byrd evoked a prompt reply from President Roosevelt. The Chief Executive immediately took the offensive and declared that, while production was perhaps not wholly satisfactory, it was generally level with earlier estimates.

Byrd had declared that the program called for average monthly delivery of only four 90 millimeter anti-aircraft guns in the last four months of 1941. Roosevelt asserted that the War Department has scheduled 61 of these guns monthly and expects to get them.

Byrd had asserted that only 15 of the 37 millimeter anti-tank guns would be produced monthly. The President replied that actual production in July was 72, that it would reach 160 in August, 260 in September, and 320 in October.

Byrd had said that only 15 of the 81 millimeter mortars would be produced monthly for some time to come. Roosevelt declared that the July output was 221 mortars with 340 expected in August and even larger quantities in succeeding months. The President agreed, however, that the figures on aircraft production in Byrd's statement were essentially correct. Byrd had charged that over-all lump figures were issued disguising the small proportion of bombers and heavy fighting planes that were actually being produced.

Many observers found in the controversy this most significant fact: that the President in his reply to Byrd had made public more authentic production data than any reporter could gather from government sources in a month of Sundays. As a matter of fact, Army regulations forbid War Department officers to discuss production figures on munitions of any kind. Occasionally this ban has been disregarded by officers of the OPM, the most notable example being William S. Knudsen's monthly announcement of total military aircraft production. Many writers feel that the present Army regulations amount to censorship and that they should discriminate between data which might be of value to the enemy and data which might be of useful public information.

Senator Byrd's statement is viewed as a possible spur to clarification of the Army regulation which has been in effect, without revision, since October 1940.

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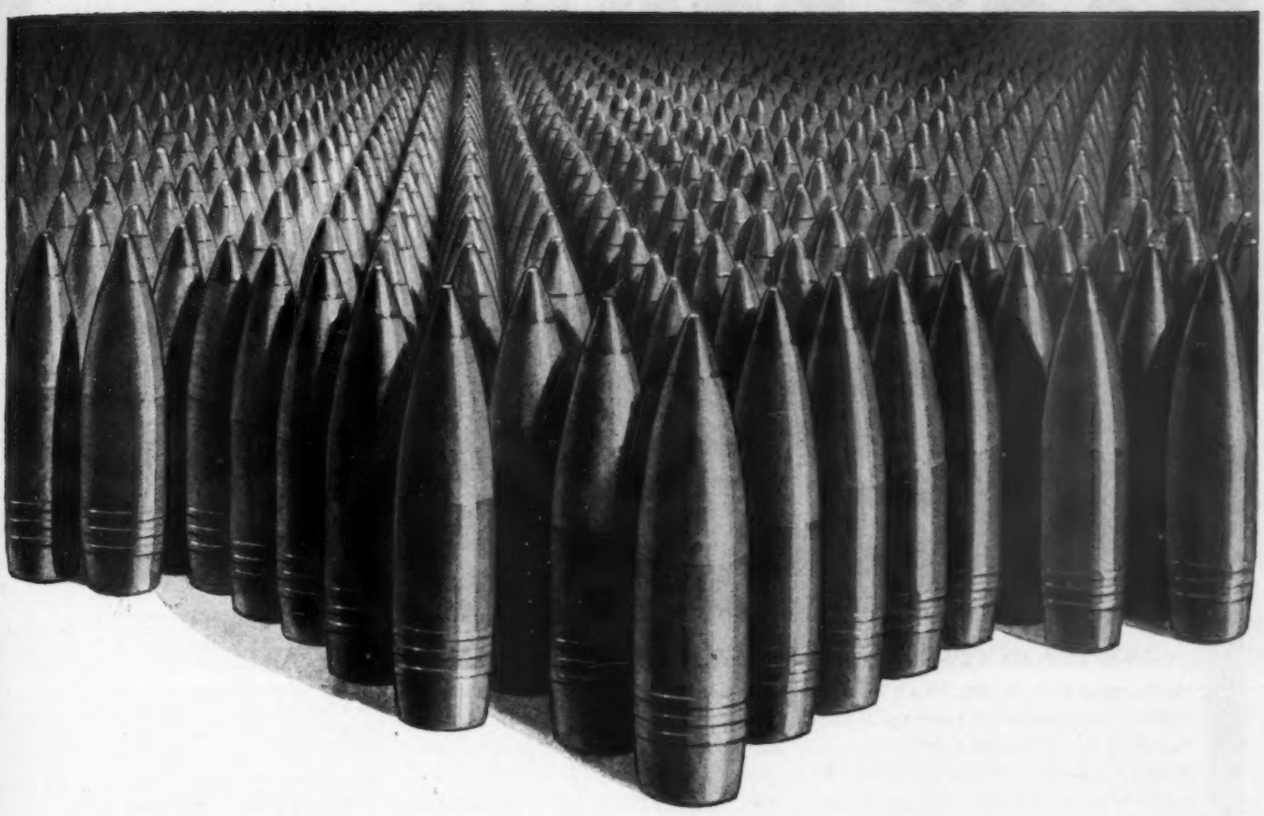

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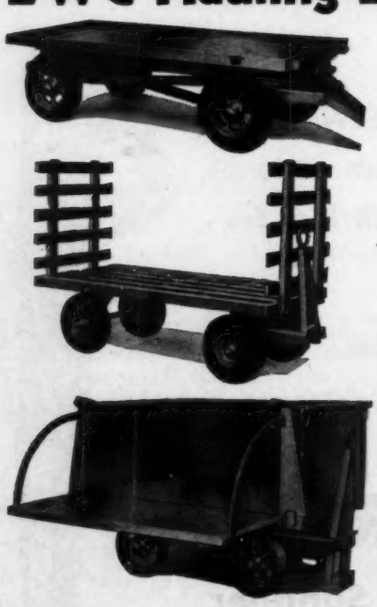

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Fingerprinting Taught in New York

As a phase of national defense, fingerprint identification is now being taught nightly in WPA Adult Education classes in New York.

Mass registration of industrial and volunteer defense workers has increased the importance of fingerprint identification and done much to allay prejudice. In a national emergency, those persons whose fingerprints are on record are assured of identification.

•

Post-War Planning Asked by Resources Group

Calling for formulation of a program to prepare for America's post-war economic readjustment, the National Resources Planning Board has issued a statement which, while it offers few solutions, depicts the gravity of the problem in its most arresting light.

"What happens to the demobilized workers and veterans and their families?" the Board asks. "Will they be without work? Will they stop producing? Will the national income drop $15,000,000,000 as soon as the pent-up demands are met? Will the succeeding drop in consumption throw others out of work and reduce national production and income another $10,000,000,000 to $20,000,000,000?

"If so, we shall be back in the valley of the depression and a terrific new strain will be thrown on our whole system of political, social, and economic life. . . . When this war is won, we can lose everything we are arming to defend if, in the transition to peace, we slip back to a low national income with its inevitable unemployment, suffering, chaos, and loss of freedom. To discover ways and to work out plans for shifting from full employment for defense to full employment for peace is a matter of national concern."

As a matter of fact, a good deal of quiet post-war planning has been going on in Washington among government and industrial leaders. It is distinctly a spare-time occupation, however, as necessarily it must be for men who are daily driving harder and harder to speed up defense production.

At least one part of the picture drawn by the Board—full employment for defense—is daily coming true. Recent estimates indicate the absorption of 4,000,000 more workers in defense industry by the year's end, offsetting the forecast of a possible 2,000,000 displaced by "defense unemployment" or, rather, unemployment resulting from curtailment of peace time goods production due to shortages.

Meanwhile, figures released by the Department of Commerce reveal that income payments to individuals in the first six months of this year were 14 percent above those of 1940. Payments for the first half of 1941 were $41,482,000,000 against $36,303,000,000 last year—indicating that the predicted 1941 total of $84,000,000,000 may well be realized or even exceeded.